DOCUMENT RESUME

ED 118 752 CE 006 194

AUTHOR	James, Frank W.
TITLE	Job Performance Aid Methods (for Job Guide Manuals and Other Formats).
INSTITUTION	Air Force Logistics Command, Wright-Patterson AFB, Ohio.
REPORT NO	DSPD-R-75-1
PUB DATE	2 Oct 75
NOTE	159p.; Some of the diagrams will not reproduce well; Prepared by the Packaging Evaluation Agency
EDRS PRICE	MF-$0.83 HC-$8.69 Plus Postage
DESCRIPTORS	Composition Skills (Literary); *Direction Writing; Grammar; Job Analysis; Manuals; *Material Development; Paragraph Composition; Task Analysis; *Task Performance; *Technical Illustration; *Technical Writing; Verbs; Visual Aids; Vocabulary; Writing Skills
IDENTIFIERS	Job Performance Aids; JPAs

ABSTRACT

The report provides simplified instructions for writing and illustrating Job Performance Aids (JPAs). JPAs are step-by-step work instructions geared to the intellectual level of the performer and background training aids for psychological task preparedness. The first two sections of the report discuss the origin of JPAs and the principles of task performance analysis. Section 3 gives detailed instructions for writing JPAs which includes guidelines on grammatical form, vocabulary, and format. Section 4 discusses the expanded uses of JPAs, and section 5 presents detailed instructions for illustrating JPAs (lighting, projections, flow diagrams, typography, and layout). Section 6 discusses modifying JPAs to meet ad hoc training requirements. Three appendixes comprise more than half the document and include a verb list and a conjunction list (which provide definitions, examples, preference ranks, and synonyms by order of preference: and a sample JPA covering foam-in-place packaging. (JR)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

JAN 26 1976

CE

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

D
DISTRIBUTION
LIFELINE OF LOGISTICS

AFPEA

Air Force Packaging Evaluation Agency

Headquarters
Air Force Logistics Command

Approved for Public Release
Distribution Unlimited

DSPD Report No. 75-1

Air Force Packaging Evaluation Agency

FRANK W. JAMES

Illustrator, Technical Equipment

JOB PERFORMANCE AID

METHODS

(For Job Guide Manuals and Other Formats)

NOTICE

When government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related government procurement operation, the United States Government thereby incurs no responsibility whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto. This report is not to be used in whole or in part for advertising or sales purposes.

ABSTRACT

Job Performance Aids (JPAs) primarily tell how tasks are to be accomplished. JPAs are step-by-step instructions for use in work areas and are also background training for psychological task preparedness. JPAs are intended for use in performance of tasks. They are based on the premise that anyone can perform technical tasks if specific instructions are given on the intellectual level of the performer.

This report includes simplified engineering writing, techniques, and illustrating instructions. Task forces and project teams who prepare JPAs are generally organized as ad hoc functions within existing and ongoing functions. The Air Force Packaging Evaluation Agency (AFPEA) will use this report as information about JPAs and as a guide in preparing Job Guide Manuals (JGMs).

This report will be available to the public from the National Technical Information Service in Springfield VA. This report will also be made available throughout the Air Force and to other government agencies upon request. Jointly with AFHRL, AFPEA has presented papers on JPAs at the National Conference of Industrial Graphics International. These have been reproduced and widely distributed.

PREPARED BY:

Frank W. James

FRANK W. JAMES
Illustrator, Technical Equipment

PUBLICATION DATE

2 OCT 1975

REVIEWED BY:

Ralph Zynda

RALPH ZYNDA
Chief, Design Division
Directorate of Packaging
& Containerization

APPROVED BY:

DUANE C. OBERG, Lt Col, USAF
Director of Packaging
and Containerization
Office of DCS/Distribution

ACKNOWLEDGEMENTS

The Air Force Human Resources Laboratory (AFHRL/AST) personnel have been of great help in researching background material. Messrs Robert Johnson, William Camm, Don Thomas, and John Klesch have cooperated in obtaining workable application for Job Guide Manuals on packaging subjects. It was with their help that adaptation has become a reality.

The first AFPEA Job Guide Manual (JGM) was coordinated through the Technical and Engineering Branch (AFLC/MMOMP) to establish the proper format. Mr. Robert Ross gave us some excellent guidance. In addition, it should be noted that Mr. Edward Earls of the Materials Division (AFLC/DSPS) wrote the text for the first packaging JGM; Mr. Perry Quijas aided with the verb list.

Three college co-op students helped in editing the Verb and Conjunction Lists located in the Appendix of this report and in the preparation of some drawings. They were Messrs Daryl Edwards, Thomas Hertenstein, and Anthony Jenkins.

FOREWORD

This report gives detailed instructions for preparing Job Guide Manuals (Sections 3, 4, and 5). It may be used to simplify engineering writing and illustrating work tasks.

Some discussion is also presented in this report on other Job Performance Aid techniques. These would include use of feedback, electronic equipment, psychological task orientation, program learning, and training aids. All of these techniques are subjects of research that should be explored much further. It is hoped that they will stimulate further development of Job Performance Aids as defined in this text.

It is recognized that some will debate the use of Job Performance Aids as the subject's rightful title. However, it is felt that there is not a more encompassing term for the total approach (in this report the communication principles behind previously established job guide and proceduralized troubleshooting aids are used). The term, JPA, has become widely used by the public and segments of the Government to mean many of the same things contained here. In addition, the term has been expanded to include areas of research in the performance of tasks (Sections 2 and 6).

8

INDEX

Cover Page i
Notice iii
Abstract iii
Approvals iii
Acknowledgments iv
Foreword v
Index vii
Summary ix

SECTIONS

Origination of the Job Peformance Aid (JPA) 1-1
Task Performance Analysis 2-1
Writing the Job Performance Aid (JPA) 3-1
Expanded Roles of Job Performance Aids 4-1
Illustrating the Job Guide Manual 5-1
Ad Hoc of the Job Performance Aid 6-1

APPENDIX

Verb List A-1
Conjunctions B-1
Examples from Foam-In-Place Packaging (TO 00-85-37) C-1

SUMMARY

1. Recent Air Force publication advancements are the PTSA and the JGM. The PTSA is a Procedural Troubleshooting Aid and the JGM is a Job Guide Manual. The premise of both is that anyone can perform a technical task without much training if specific instructions are given in a series of descriptive steps.

2. The Directorate of Packaging & Containerization is interested in only the JGM. Packaging personnel are not often called on to troubleshoot; therefore, PTSAs would be used infrequently. However, much of the technical information about JGM is found in engineering and research papers or reports that do not distinguish clearly between JGM and PTSAs. They were developed together under project, "Preparation of Information for Maintenance and Operations (PIMO)," initiated in September 1964 and go by the subject title of Job Performance Aids (JPAs). The Air Force Human Resources Laboratory (AFHRL/AST) at Wright-Patterson AFB OH of the Air Force Systems Command (AFSC) have overseen the project until it ended April 1969.

3. The concepts of PIMO were developed into volumes of reports. These were later used to prepare guides for dual language text in Vietnamese and English as part of the Vietnamization effort as the U.S. withdrew from the war. These publications were called Job Performance Aids. In December 1973 (this was after Vietnamization), new guides for only English versions were developed and called, "Fully Proceduralized Troubleshooting Aids." Both in private industry and military the title, Job Performance Aids, has now come to mean a method of preparing tasks in logical series of steps to be used during training and whil performing actual tasks at job sites.

4. The Boeing Company's Vertol Division has taken the JPA concept to the public consumer. They have prepared the Volkswagen Handbook on "The Beetle and Super Beetle," Fiat electrical system troubleshooting aid, and the dealer's manual for the Yamaha motorcycle (including crating instructions).

5. Since these first adaptive efforts of the PIMO project in 1972, there have been many applications made. A handbook to aid ladies in doing repairs around the home was prepared and advertised on national TV. It seemed feasible that packaging would have some direct application for JPAs. Our preliminary research indicates that this is so.

6. The PIMO reports indicate that performance of experienced specialists and performance of unexperienced technicians proved to be effectively equalized by JPAs. Technicians using JPA handbooks under test conditions committed no measurable errors. This was a performance unequaled by technicians performing tasks with other technical publications. Manpower effectiveness was increased from 25-50 percent. This would indicate better use of packaging personnel should be a by-product of packaging JPAs.

7. Since packaging engineering data is sometimes difficult to use, AFPEA has been striving to improve communications with field personnel. It was felt that JPAs could be a good approach. The first trial effort was published as an attachment to AFLC CMAL Number 73-3, Distribution Packaging, in May 1973. The results were very favorable. After this first effort, it was decided to produce a second publication expanding much of the same material. Work has been completed on T.O. 00-85-37 on the subject of foam-in-place. The AFPEA's management agreed to have their illustrator spearhead the project. This was done, in part, because the weakness of the JPA research was in illustrative technology. The JPA relies heavily on illustrations.

8. A look down the pike to the future of the JPA shows some real innovative applications not yet fully explored. Most of these concern psychologically preparing writers for specific approaches. The majority is therefore related to education and training. Others are related to feedback and updating systems. Subjects like videotape, program learning, on line communications, and environmental orientation will become part of the vocabularies of JPA preparers.

9. WRITING JPAs:

a. The AFPEA's writers are engineers and technicians who generally use highly technical approaches. Converting to the simplified JPA style requires considerable training. For example, the JPA style for 8th grade reading level is:

(1) Maximum words per paragraph - - - - - - - - - - - 30.

(2) Maximum words per sentence - - - - - - - - - - - 15.

(3) Sentences constituting one paragraph - - - - - - 3.

(4) Maximum paragraphs for each task step - - - - - - 3.

(5) Maximum elements per step - - - - - - - - - - - - 17.

(6) The sentences are generally arranged in the following order:

(a) Subject

(b) Verb

(c) Object

(d) Predicate Object

(e) Indirect Object

b. In analyzing writing problems, it was found that our writers over used conjunctions. Therefore, a list of conjunctions was established and included in the appendix. This helps to recognize conjunctions and to begin dropping most of them when preparing text copy for the JPA. Sentences should never start with conjunctions.

c. A verb list was made containing words used in packaging and added to the aircraft maintenance list to describe technical acts. This list includes the verbs, definitions, examples, preference rank, synonyms by order of preference, and notes. This was done in an effort to convert the established JPA jargon for packaging use. This list is also in the appendix.

d. The observation test should be based on sound engineering practices. To aid in this approach, a system has been suggested. It employs an action tree of tasks and full written descriptions of tools, supplies, steps and stops. Ad hoc terms are used to staff these efforts while still maintaining other ongoing functions and responsibilities.

10. ILLUSTRATING JPAs: The first effort was to establish minimum requirements for illustrations as listed below. Most of these have been already adapted now by AFHRL; however, it should be noted that some of them are being reevaluated.

a. Line art is usually used. The art work should be reproducible by any printing method. In addition, no line should be reproduced in the publication which is less than .005 wide (a little less than 1/128 of an inch). This can be accomplished by using crape tape that is no less than 1/64 and by not reducing the original art more than 50%.

b. Improperly drawn screw threads which would fill in, when reproduced, are unacceptable.

c. Strippling shall not be used as a shading method.

d. Thick-weight lines should be used for shadowed areas, while thinner lines are used for areas that would receive more light. It is recommended that the light for bird's-eye views should come from the upper right side at an angle of 45°; in worm-eye views from the lower left side. (To me, an alternate method is acceptable that is of silhouetting objects with heavy lines and using lighter lines for interior details. This, however, has not been adopted yet.)

e. Reflected light off of glossy surfaces (nicknamed nonlines) shall be used on all rounded features. These should be broken up in a mixture of short and long dashes with varying space between the dashes. This avoids confusion with center and phantom lines.

f. Object lines are broken 1/128 - 1/16 inches from overlaying features. This avoids confusing lines that bunt together with those that pass over/under each other.

g. Details that confuse the information contained in the text or conceal by reducing focalizing on key details or hardware shall be dropped out.

h. When illustrating, the angle of view, as seen by technicians performing the task, shall be used to render the drawing. Rotation of items is possible if those rotations are clearly given on the illustratio

i. In exploded views the parts will be shown aligned on center lines drawn to their actual location when assembled.

j. A locator illustration will be used to identify equipment items within a system. The item will then be located alone on the rendering along with an arrow from the location silhouetted on the systems overview.

ORIGINATION OF THE JOB PERFORMANCE AID (JPA)

SECTION 1

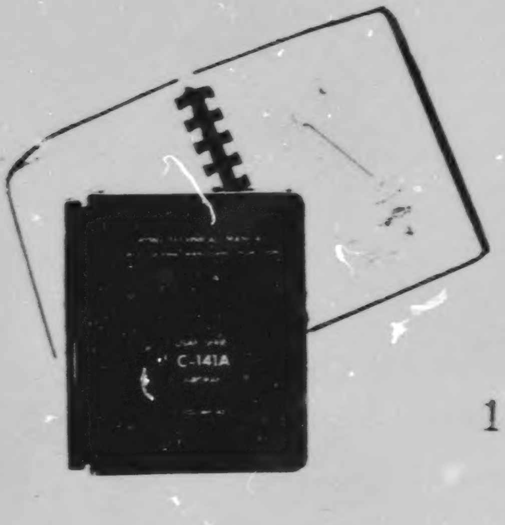
1-1. Premise

Recent Air Force publication advancements in technical manuals are the PTSA and the JPA. The PTSA is the Procedural Troubleshooting Aid while JPA is the Job Performance Aid.

Specific instructions are given in the JPA and the PTSA. These are given in illustrated steps with descriptive text instructions.

Any one can perform technical tasks without special training. Specific instructions must be on the intellectual level of the performer. A series of descriptive steps must also be given.

1-2. Project Preparation of Information for Maintenance and Operations (PIMO)



The JPA and the PTSA were developed together. It was initiated in September of 1964. Project Preparation of Information for Maintenance and Operations (PIMO) was the development title.

The Air Force organization overseeing PIMO was the Air Force Human Resources Laboratory. The first effort was completed in April of 1969. PIMO started a number of related projects that are still continuing.

This report is only concerned with the Job Performance Aid (JPA). PIMO data will be used as it relates to the JPA.

1-3. Packaging Manuals and PIMO

Majority of Air Force packaging manuals have been written on an engineering level. There have been no manuals designed for line personnel. Manuals are used by both engineers and the lower skilled personnel.

The PIMO trend should indicate the direction of packaging if tests were conducted. Some of PIMO test results are given. Others that cannot be related to packaging have been discarded.

Maintenance publications have always been prepared for nonengineers. Packaging results with the JPA should be better than with PIMOs. The results of packaging JPAs should be quite dramatic.

1-4. First Contracted JPAs

Seredipty Incorporated contracted for the UH-1H Helicopter System. R.M. Parson's Company contracted for the Back-up Interceptor Control System. There have been many others like the C-7A, C-141A, F5E, etc.

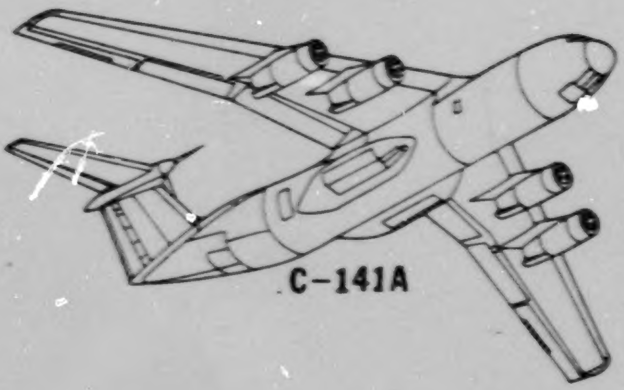
Many of the JPAs were dual Vietnamese and English. Military Specification MIL-J-83302, Job Performance Aids, Advanced Type, for Vietnamese National Air Force Organizational Maintenance was used to prepare them.

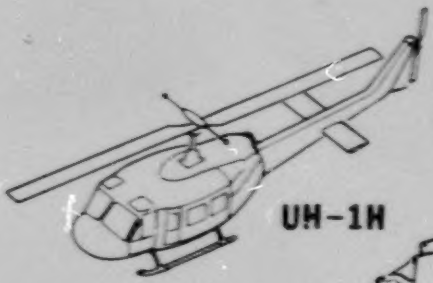
Fire truck and ground generator JPAs have also been prepared. These were the first nonaircraft maintenance subjects to appear formatted as JPAs.

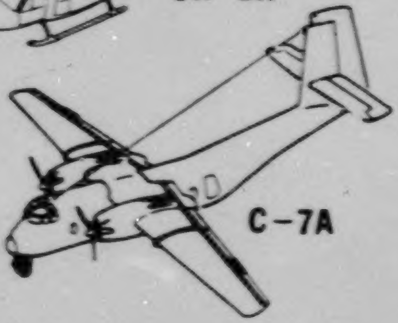
1-5 PIMO Test Locations

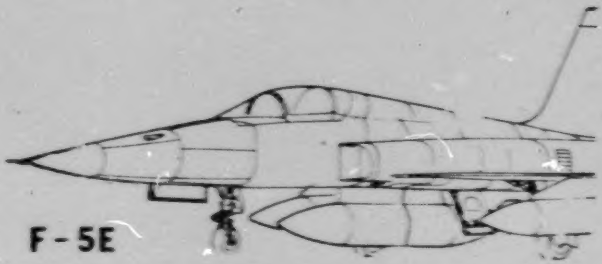
Tests were conducted at Charleston AFB, Dover AFB, and Norton AFB. They were initiated in January and ended in November of 1968. Tests were not made on aircraft in active command mission duty.

Test results are hypothetical for fully augmented mission support activities. Aircraft and personnel were assigned to the test. These were cross-sectioned representations used for validation.


C-141A

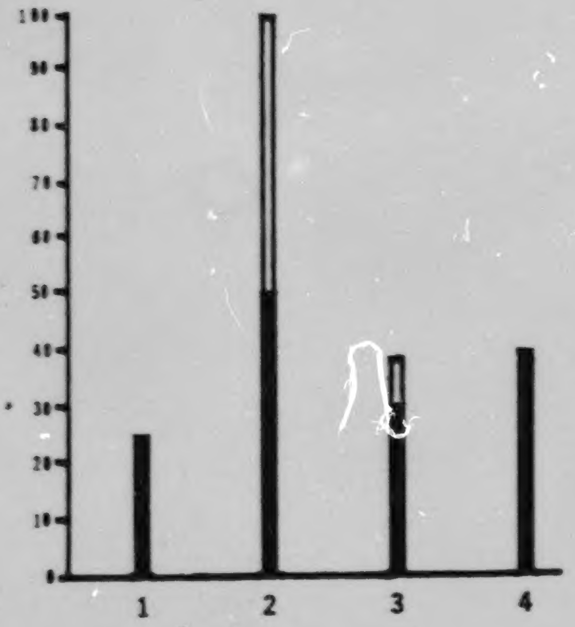

UH-1H


C-7A


F-5E

1-6. PIMO Test Results

These results concern aircraft maintenance only. Results from conversion to other subjects are not known. No tests are planned to validate using JPAs for packaging information.



PIMO test summary indicates:

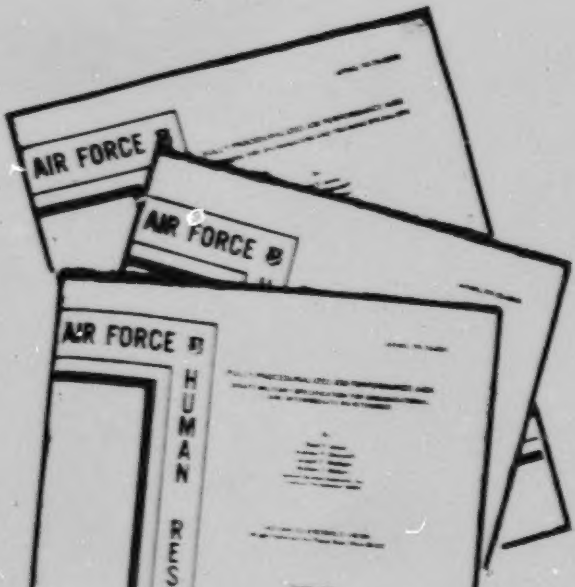
1. Training time is decreased by 25%
2. Errors in performing tasks are decreased by . 50-100%
3. Manpower demands decreased by 30-39%
4. Operational readiness increased by 38-40%

NOTE

PIMO's eight volume report is available from the National Technical Information Service (AD-852-101 through 108).

This report is the first attempt to describe conversion to packaging JPAs from nonaircraft maintenance subjects.

1-7. Air Force Human Resources Laboratory (AFHRL) Further Refinement of the JPA



The Air Force Human Resources Laboratory developed the proceduralized JPA. The first three volume report was published in December of 1971. It was further developed into MIL-J-83302.
The first set of reports (AFHRL-TR-71-53, Fully Proceduralized Job Performance Aids) set forth guides for dual Vietnamese and English text. A second set of reports for just English was published in December 1973 (AFHRL-TR-73-43, same title).

The second set is being used by AFPEA in developing the packaging JPA. The sets also formed the basis of MIL-M-38800A, Manuals, Technical: Organizational Maintenance Instructions (for Aircraft, Missiles, Ground Communications - Electronics - Meterological Equipment, Vehicles, and Various Other Equipments).

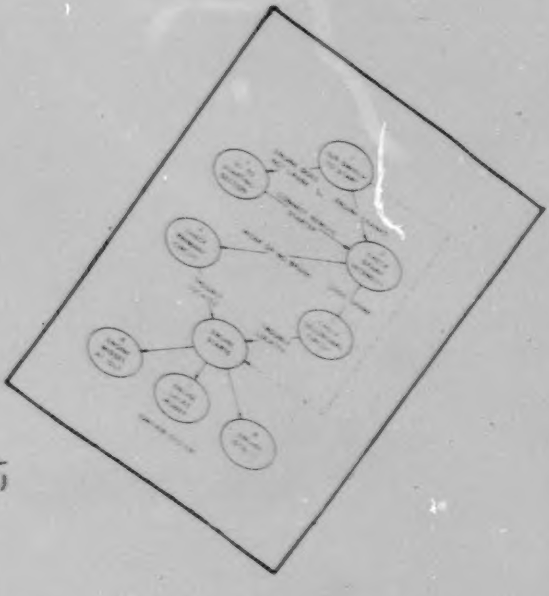
1-8. Air Force Packaging Evaluation Agency (AFPEA) Contact with AFHRL

In February 1973 representatives of the Air Force Packaging Evaluation Agency (AFPEA) contacted the AFHRL. This resulted in AFPEA adapting the JPA to package engineering.

AFPEA published its first drafted formatted JPA as an attachment to a command letter.

The joint effort with the JPA is causing favorable response by industry. Representatives from AFHRL and AFPEA spoke at the Industrial Graphics International Conference in June 1974. A large segment of industry is interested in adaptation of the JPA for consumer markets.

1-9. Industrial JPA Application by Vertol



Boeing's Vertol Division was one of the first to take the concept to the U. S. consumer. They prepared the Volkswagen's (a JPA) handbook. Also prepared was Fiat's (a PTSA) dealer's manual on the electrical system.

Vertol prepared the first commercial JPA descriptive section on packaging. It appeared in the Yamaha's motorcycle dealer's manual.

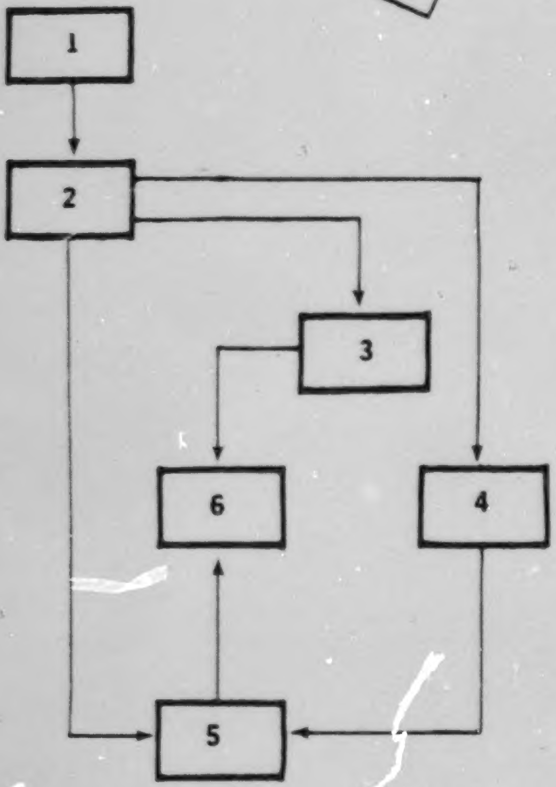
Vertol's adaptation indicates that there are many feasible applications for the JPA. Preliminary investigation show that AFPEA can use some of these applications.

NOTE

Additional information about Vertol's adaptations can be found in February 1973 issue of Industrial Art Methods. The article is by R. W. D. Buchstone titled, "JPA - The New Look in Illustrated Manuals."

1-10. Proposed Procedures for Adaptation

The following is a flow of objectives. They are not milestones.



1. Formulate a list of verbs used in packaging to be added to those furnished in MIL-M-38800, Manuals, Technical: Organizational Maintenance Instructions (for Aircraft)

2. A set of instructions on how to prepare packaging JPAs to be used by engineers and technicians to write Technical Orders (TOs)

3. Development of a training course for new packaging employees

NOTE

It is hoped that much of the effort will be done through the Joint Military Packaging Training Center (JMPTC) at the Aberdeen Proving Ground. In this way all Department of Defense (DOD) packaging activities can benefit.

4. Efforts would begin to update present Air Force packaging TOs into the JPA format

5. Be of assistance in development of JPA formatting throughout the Air Force Logistics Command

6. Encourage Department of Defense use of the JPA format through development of packaging training courses and AFLC's adaptations.

TASK PERFORMANCE ANALYSIS

SECTION 2

2-1. Job Performance Aid (JPA) Task Analysis

Before a JPA can be written around a set of tasks there must be background analysis. The analysis is conducted to find the easiest method of performing tasks. Task performance should be tried and proven before becoming a part of a JPA.

Task Analysis involves time-and-motion studies. Engineers will be developing better methods, equipment, and products by observing tasks under test conditions.

Many packaging tasks have become systematic. Line personnel pass along information to fellow workers. The tasks are not always engineered.

2-2. Observing Tasks

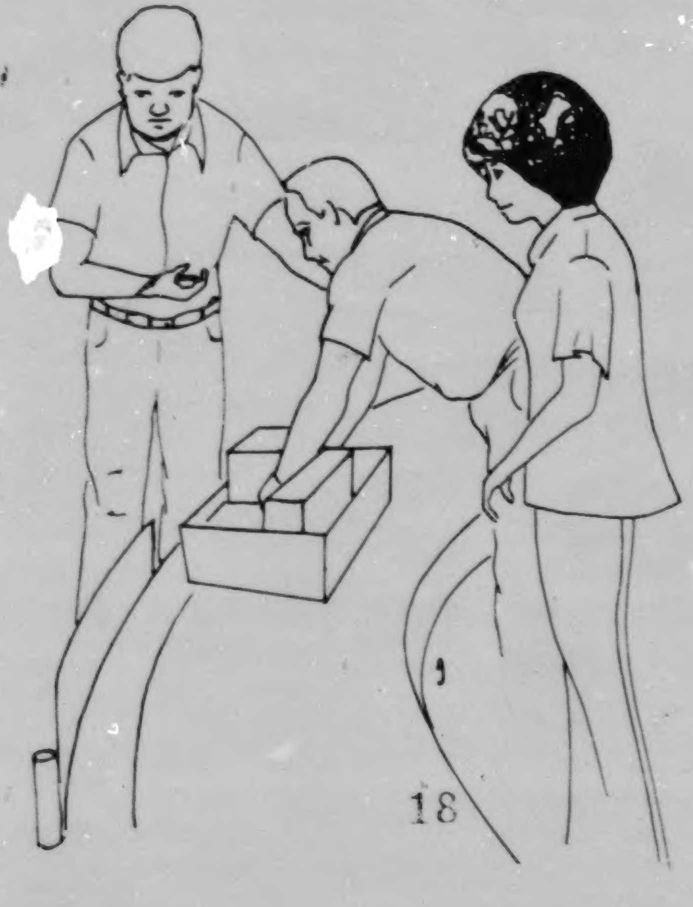
There are a number of ways to observe a task while making a record for analysis. One can make a complete time and motion study. With a shortage of manpower, this will not always be possible.

NOTE

> This report will not spell out methods for lengthy analytical studies. Engineers assigned to such tasks should draw on text devoted to those subjects.

There are a number of people that should be observers. They are writers, illustrators, editors, and engineers.

A record of observation is a requirement for validating JPA data. These can be written, sketched, photographed, videotaped, or tape recorded. All of the team personnel preparing the JPA should then review the observation.

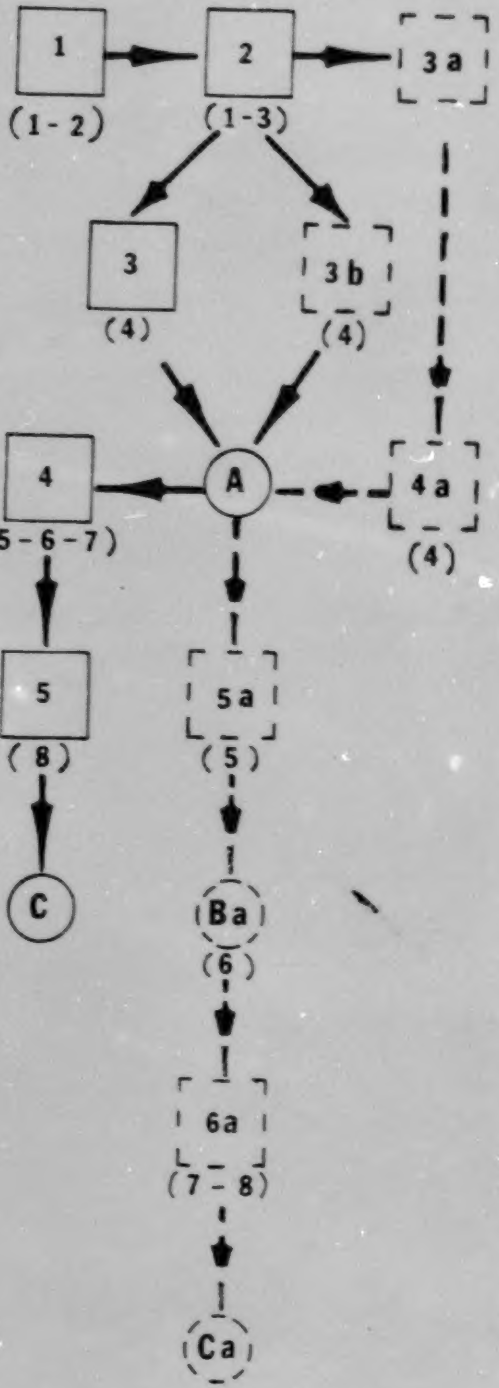


2-3. Written Observation Lists

List each tool, equipment, and supplies to do the given task. Write a description of each item not common to the less than average "around the house do-it-yourself" type person. Number the items numerically in parentheses.

List in numerical order each step in the task. Include a subparagraph describing the step in detail. Indicate alternate methods as subnotes.

List all points where the tasks are stopped. These can be for quality control checks, equipment checks, tests, curing time, etc. Assign an alphabetical letter(s) to each.



2-4. Observer's Action Tree

From the written observation list develop an action tree. The numbers and letters must correspond to the written observation.

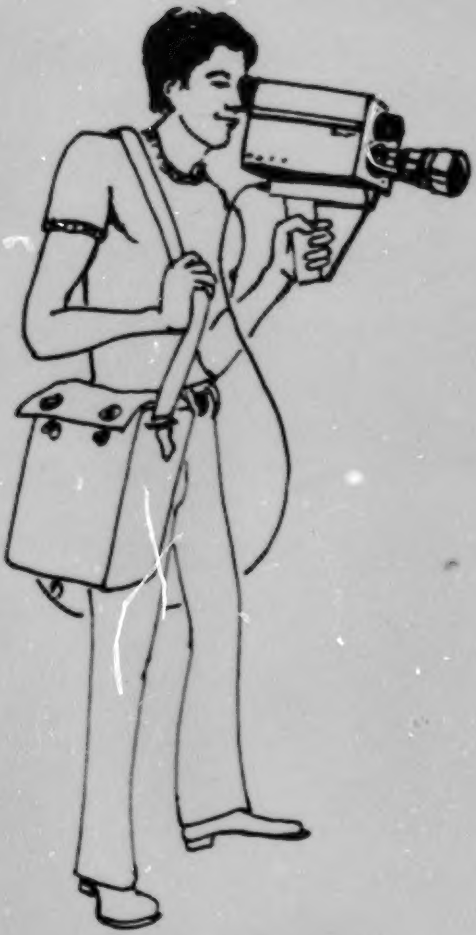
1. Tools, equipment, supplies, etc are numbered and enclosed in parentheses.
2. Task steps are numerically numbered and enclosed in squares.
3. Each stop alphabetical letter is circled.

Arrows are drawn to each step and stop in the order of their occurrence. Parentheses of items needed for the task or stop appear directly under the square or circle.

Alternate steps and stops are given on the same diagram. Arrows to these are dashed.

NOTE

Engineering changes in procedures of tasks should be mapped out using action trees. All task steps appearing in the JPA should be established by action trees.



2-5. Sketched Observations

Illustrators observing tasks will want to sketch as many of the procedures as possible. These should be quickly dashed off for refinement later. Order of tasks and engineering data should be maintained by other observers.

2-6. Photographed Observations

Photographs are used later to make line drawings of tasks to appear in the JPA. Much care must be given to include many close-up shots. A record of the order of shots must be maintained.

NOTE

Photography includes stills for prints, slides, and motion pictures.

2-7. Videotape Recording Observations

Videotaping is a good method for a team developed JPA. This reduces the number of observers required to be present during a test. The team is able to observe the task from the same advantage point.

The videotape can be used by the artist to develop the illustrations. The tape may be stopped at any point for details.

The written observation lists and action trees can be developed from videotape.

2-8. Sound Recording Observations

A small tape recorder can be used to narrate task observations. Care must be given to describe in detail what is seen. Descriptions to be filled in later with write-ups should be avoided.

NOTE

No numbering of the dialog should be attempted while recording.

2-9. Task Developing

The technician develops a written format into logical steps. Observation can then be used only to substantiate task procedures.

The technician develops a written task analysis. This would include items, tasks, and stops supported by action trees.

Tests are then run. One or more of the observation methods are used.

2-10. Remote JPA Developers

Very often the developers of JPAs are removed from the task site. This is sometimes by miles, time, adequate space, etc. Some method of gathering data is required.

The gathering of such data can be done by photographs and phone calls. People like to talk about their work tasks. They usually like pictures of their work taken.

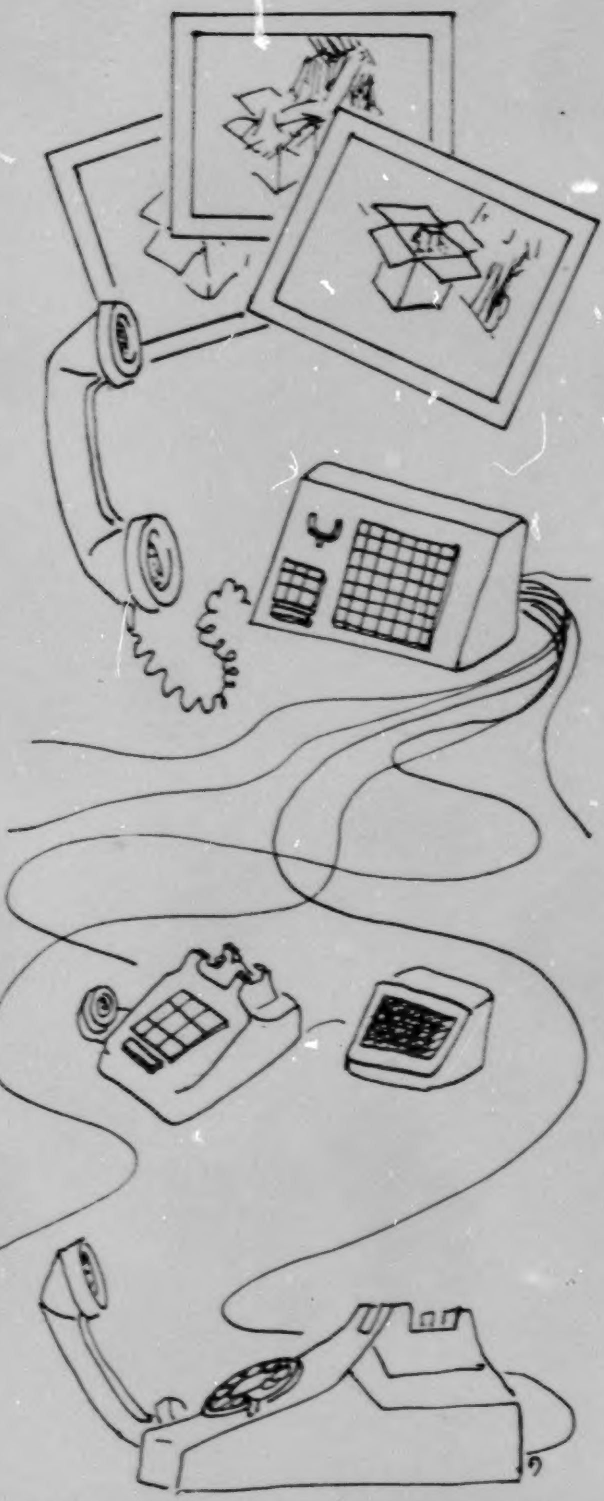
The most difficult problem is to get information directly from the performers of tasks. This action is often blocked by administrators. Information passed on by administrative communication usually lacks details.

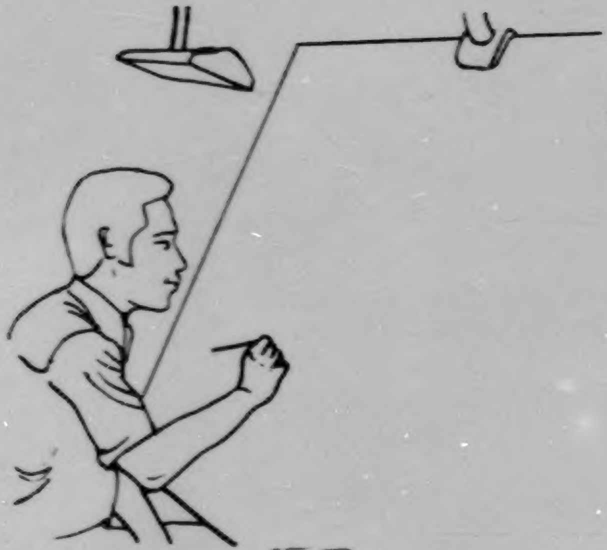
NOTE

> Interviews with persons performing tasks are an essential part of JPA development. It should not be avoided.

2-11. The JPA Team Developers

The JPA is a collection of engineered tasks. The tasks are so arranged that persons of low reading and technical skills can complete the series of logical steps. These steps are well illustrated.





Technicians develop and test the task steps. Writers express these steps for low reading skills. Illustrators show these steps in visuals that can be followed.

The JPA team developers can be in the person of one. The contributors can be a large staff not necessarily under the same roof. Ideally the team is made up of:

1. Engineers/technicians
2. Writers
3. Illustrators

2-12. Contributors

Contributors are every person interviewed or observed that have any knowledge about a task. They validate the JPA data.

Photographers, technical assistance personnel and many others contribute directly to the JPA. They are the support personnel.

Data centers for computer information have direct input into the JPA. Any system used to gather and dispense information are potential contributors.

2-13. Milestones in Preparing the JPA (Summary)

1. Develop task analysis.
2. Validate the analysis by observation.
3. Team effort the content of the JPA.
4. Publish a draft.
5. Repeat steps one through three.
6. Publish the final JPA.

WRITING THE JOB PERFORMANCE AID (JPA)

SECTION 3

3-1. Prerequisite

Only after the task performance engineering (Section 2) is completed can the actual writing begin. It is now a matter of putting the tasks in the right language and format.

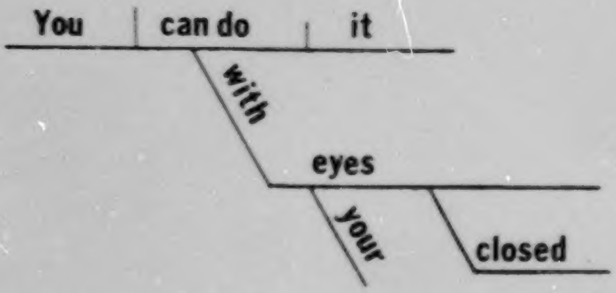
Writers should have a knowledge of the vocabulary limitations of the JPA reader. Adult reading skills range from fifth grade to graduate school levels. Example:

1. 5th grade - Liquid A and B are mixed to produce foam.

2. 8th grade - Compound A and B are combined to produce urethane foam.

3. College - Isocyanate and hydroxyl containing resin with a blowing agent produces urethane foam.

4. Graduate school - $R{-}NCO + R'{-}OH \rightarrow R{-}\overset{H}{N}{-}\overset{O}{\overset{\|}{C}}{-}OR' + \text{heat}$ are reactive ingredients of polyurethane foam.



3-2. Mood

Second person imperative mood is used to give step-by-step instructions. The third person indicative is used for descriptions and discussions.

3-3. Sentence Structure

The reading skills of the JPA user determines sentence structure. The fifth to eighth grade reading levels must be generally arranged in the following orders.

1. Subject - implicit, except when more than one.

2. Verb - a verb list should be developed for the subject area.

NOTE

A verb list for packaging and aircraft maintenance is included in the appendix.

3. Object - specific tools, items, or equipment.

4. Predicate object - qualifying conditions.

5. Indirect object - locations

The word "using" should precede tools, equipment, or supplies.

Verbs used to describe a task action in packaging or aircraft maintenance should be selected from the verb list. Consistency of meaning is a key factor in JPA writing. Consistency also aids in skim reading.

3-4. Lengths (Maximums)

The reading skills of the JPA user determines the length of sentences and paragraphs.

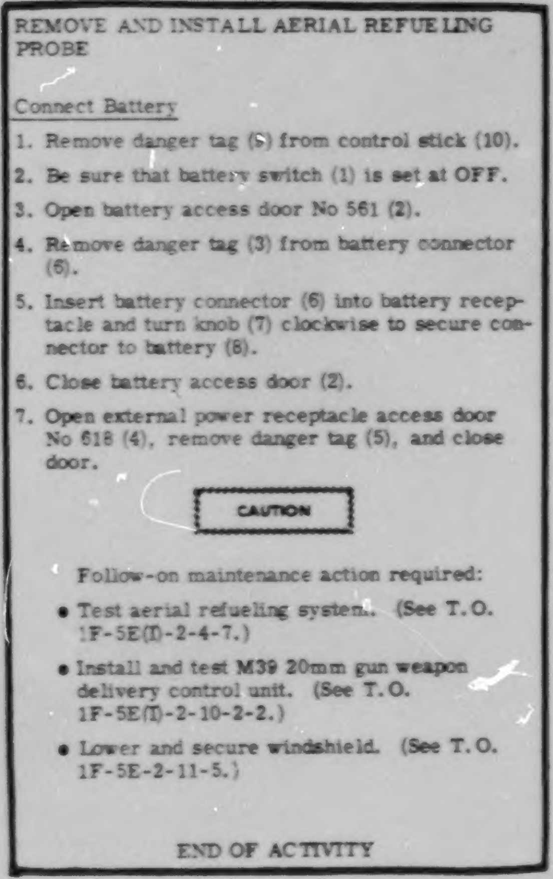
1. 5th grade - No more than 25 words per paragraph with no more than 10 words in each sentence. Only three sentences per paragraph.

2. 8th grade - No more than 30 words per paragraph with no more than 15 words in each sentence. Only three sentences per paragraph

READING LEVEL	No. of WORDS Per PARA.	No. of WORDS Per SENT.	No. of SENT Per PARA.
5	25	10	3
8	30	15	3
16	40	17	4

NOTE

The eighth grade standard is usually used. This has been the established average American adult reading skill level.



REMOVE AND INSTALL AERIAL REFUELING PROBE

Connect Battery

1. Remove danger tag (9) from control stick (10).
2. Be sure that battery switch (1) is set at OFF.
3. Open battery access door No 561 (2).
4. Remove danger tag (3) from battery connector (6).
5. Insert battery connector (6) into battery receptacle and turn knob (7) clockwise to secure connector to battery (8).
6. Close battery access door (2).
7. Open external power receptacle access door No 618 (4), remove danger tag (5), and close door.

CAUTION

Follow-on maintenance action required:

- Test aerial refueling system. (See T.O. 1F-5E(I)-2-4-7.)
- Install and test M39 20mm gun weapon delivery control unit. (See T.O. 1F-5E(I)-2-10-2-2.)
- Lower and secure windshield. (See T.O. 1F-5E-2-11-5.)

END OF ACTIVITY

3. College (16 years of schooling) - No format has been established. An increase to 40 words per paragraph seems acceptable. Three sentences per paragraph can be relaxed to include an occasional four.

NOTE

Compound titles, names, and numbers are counted as one word. Grouped titles are counted as one word.

3-5. Paragraph Arrangements (Maximums)

Three paragraphs may be arranged under short subtitles. This aids in scanning. Subtitles only are numbered.

Three subparagraphs may be arranged under numbered introductive paragraphs. The introductive and subparagraphs are grouped into sets under short subtitles. Ideally this produces a maximum of twelve paragraphs per subtitle.

NOTE

Items in 3-6 are not considered in paragraph maximums.

Each paragraph may be numbered under subtitles. No more than 17 paragraphs in JPAs should be included under a subtitle.

NOTE

MIL-M-38730, General Requirement for Preparation of Technical Manuals shall be used for this numbering system.

3-6. One Line Numbered Listings, Notes, Cautions, Warnings, Preliminary Instructions or Information, Special Instructions or Ending Instructions

Under any paragraph may appear one line numerical listings. There should never be more than 17 task items (preferably less) per paragraph.

NOTE

List of tools, supplies, etc may be expanded to full totals. They may exceed the 17 maximum.

Notes, cautions, warnings, preliminary instructions or information, special instruction or ending instructions shall be constructed as subparagraphs. Rules of paragraph structures are binding on them.

Notes, special instructions, and ending instructions come after related paragraphs. All others of the above must proceed their related instructional text.

WARNINGS MUST COME FIRST
TO AVOID DISASTERS.

3-7. Keying Text and Cross Reference

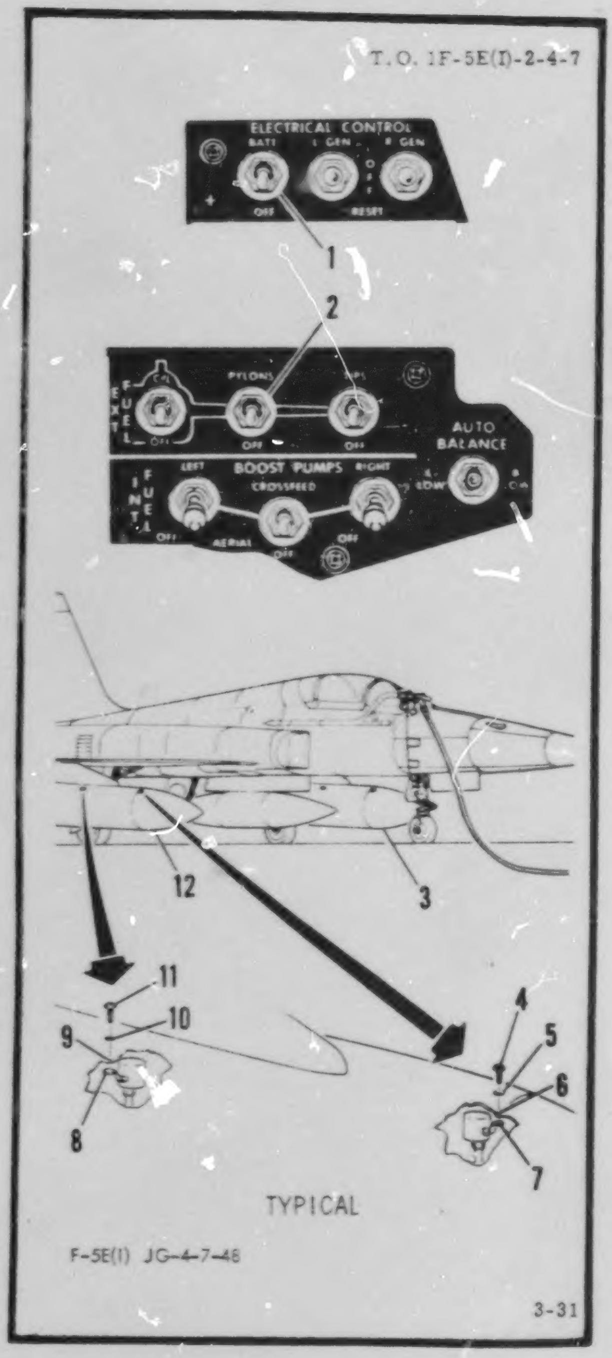
Text copy may make a number of references to the illustration. The copy should include a numeral (parenthetically) locator. That number is shown in an open face arrow on the illustration.

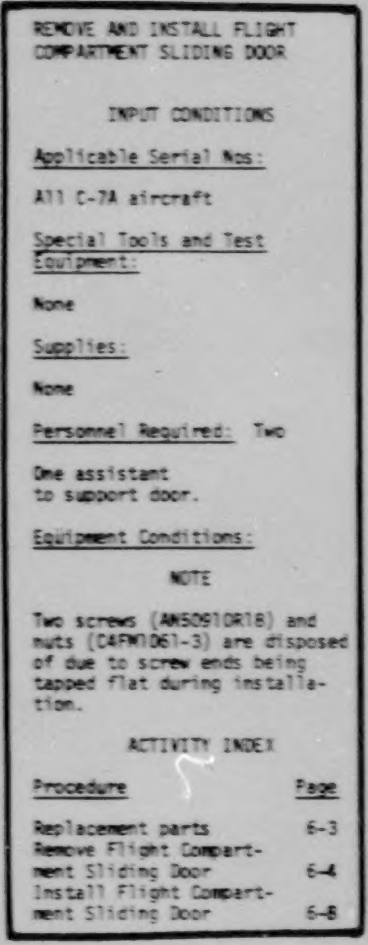
Cross references should give the volume number and subtitle number or page number. Step texts should not be repeated in their entirety.

3-8. Engineers, Technicians, and Illustrators Writing Job Performance Aids (JPAs)

Other than technical writers are pressed into writing JPAs. This is usually due to shortage of manpower, proven skills, or administrative policy.

Such writers usually have problems with simplicity and directness. They also tend to rush their writing. Writing to them is an added duty.


T.O. 1F-5E(I)-2-4-7
ELECTRICAL CONTROL
BATT
L GEN
R GEN
OFF
RESET
1
2
EXT FUEL
CTR
PYLONS
TIPS
OFF
AUTO BALANCE
BOOST PUMPS
LEFT
RIGHT
CROSSFEED
INT FUEL
AERIAL
L LOW
R LOW
12
3
11
10
9
8
4
5
6
7
TYPICAL
F-5E(I) JG-4-7-48
3-31



REMOVE AND INSTALL FLIGHT COMPARTMENT SLIDING DOOR

INPUT CONDITIONS

Applicable Serial Nos:

All C-7A aircraft

Special Tools and Test Equipment:

None

Supplies:

None

Personnel Required: Two

One assistant
to support door.

Equipment Conditions:

NOTE

Two screws (AN509IOR18) and nuts (C4FW1061-3) are disposed of due to screw ends being tapped flat during installation.

ACTIVITY INDEX

Procedure	Page
Replacement parts	6-3
Remove Flight Compartment Sliding Door	6-4
Install Flight Compartment Sliding Door	6-6

Here are a number of helpful hints:

1. Use the verb list to search out descriptive words.

2. Never start sentences with conjunctions.

3. Reduce the number of thoughts joined by conjunctions.

4. Put the subject of sentences first.

5. Put qualifying conditions and locations at the end of sentences.

NOTE

A verb and a conjunction list are at the end of this report.

3-9. Other Guides

The writing format here is a summary of AFHRL-TR-73-43(1), Fully Proceduralized Job Performance Aids. Some adaptation explanations have been made for preparing packaging JPAs. These are:

1. Breakdown of reading levels - AFHRL report is based on the eighth grade level.

2. Three choices of paragraph arrangements are given. This is because of the difference in maintenance and packaging technical order series.

3. AFPEA is hoping to structure a training guide using the JPA format.

4. The ease of skim reading text and illustrations by persons not familiar with manuals.

5. At the AFPEA, engineers and technicians are primarily used for writing JPAs.

MIL-M-38730 and MIL-M-38800 are the two AFLC guide requirements. No real guides devoted to just the JPA as adapted for packaging now exists.

The best guide at present is MIL-M-38800A - as modified for A-10A aircraft. It is titled, "Organizational Maintenance Instructions (for Aircraft, Missiles, Ground Communications - Electronics - Meterological Equipment, Vehicles, and Various Other Equipment) Technical Manuals." It was prepared by the Air Force Systems Command.

EXPANDED ROLES OF JOB PERFORMANCE AIDS (JPAs)

SECTION 4

4-1. Impartation of Knowledge

JPAs are well illustrated and discussed instructions on task subjects which impart specific instructions. JPAs may be printed, filmed, recorded, computerized, environmentalized, or mechanized. They impart knowledge about tasks.

Knowledge imparted may be for future or for immediate tasks. JPAs may be for abstract or physical tasks. Instructions may be on singular or collective tasks.

JPAs primarily tell exactly how a task is to be accomplished. They act as guides through mazes of possible solutions. All JPAs give step-by-step instructions.

4-2. Nigh to Work

JPAs are used during the act of task performance. They are kept nigh to work tasks. They tell exactly how tasks are to be done.

JPAs are designed so that anyone can follow the given series of steps. These are used on task sites. The format for these JPAs can vary.

JPAs can be publications or printouts from electronic communications taken to task sites. They may also be taken to task sites as videotape or as visual aids. They are viewed while performing tasks.

4-3. Training for Tasks

Some tasks require knowledge of set ups before task performances. Some environments require knowledge before a task is performed within them. Some tasks require knowledge of special tools, equipment, supplies, or systems.

NOTE

> More information about training is given in SECTION 6. Such tasks require training. Again the JPA is used. This time it imparts pre-knowledge requirements.

Text books and lessons can be prepared as JPAs. Programmed learning techniques could be used. Visuals, simulators, panoramas, and psych-corp art can also be used to aid in psychological preparedness.

NOTE

> Psych-corp art usually is walk-in panoramas complete with sound, smell, feel and visual sensory aids. They have been widely used in Walt Disney lands. It is the art of transporting environments with technical equipment to produce realities.

The training JPA is used in conjunction with nigh to task JPAs. Together they form a bank of knowledge. JPAs impart knowledge comprehensively to performers of tasks.

4-4. Comprehension

The JPA must be prepared for segmented audiences. Vocabulary, visual symbolism, and prior education are level considerations that determine JPA formats. They are always prepared for the projected inexperienced performers.

The United States' average adult reads on the 8th grade level. The lower range would be 5th grade. This would mean 5th grade levels should be used for the general public.

Young persons have higher levels of reading skill than the average adult. People finishing the ninth grade should have 8th grade reading skills. Reading skill development usually stops at this point.

Symbolisms are highly developed in highly technical societies. This is largely due to family TV programs. The average skills in this area have never been academically tested or workably defined.

4-5. Encapsulation of Environments

Moving trainees to total environments using JPAs has been tried. Simulators, models, and panoramas are not new. Accidental formats may have occurred but not called JPAs.

Systematically engineered tasks organized as training JPAs need to be forthcoming.

Psych-corp art has not yet been explored as JPAs. It is only a matter of time when the JPA will be produced for outer space (or under sea) environments for organized task performance training.

4-6. Future of Job Performance Aids

The JPA will be increasingly transmitted to task sites by electronic communications. These methods will allow for better feedback systems to be developed. Updating information is very rapidly transmitted.

The JPA will become programmed for learning. Electronic visual aids will be prepared using JPA formats.

Creating environments for training will become part of the total approach. Task environments for training are just as important to success as on site descriptive instructions for job performances. JPA developers will eventually use psych-corp artists as well as industrial artist.

4-7. Packaging JPA Developments in the Future

The Job Guide Manual format will be further developed. Other areas for the JPA will be examined. These could be in the area of standardization publications and transportation packaging orders.

Packaging training JPAs will become a reality. These may depend on the Joint Military Packaging Training Center's (JMPTC) or other interested organizations.

Plans for any environment orientation JPAs have not been made. There are other subjects that will probably be developed first.

4-8. Feedback System for Packaging

Preparers of JPAs need to know the skill levels of performers. These levels are always changing because of education and social background of personnel. Job markets never remain constant.

Words change meanings and knowledge of symbols increase constantly. The art and the text must keep pace. Revisions can be a nightmare unless feedback systems are developed.

Packaging JPAs do have this inherent problem. Part of any future development must deal with feedback. A number of ideas are proposed in Section 6, Title 5.

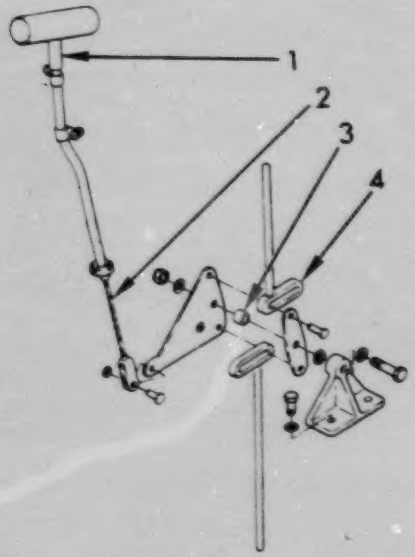
SECTION 5

5-1. Minimum Requirements

Art work should be reproducible by any printing method. Photographs should not be used unless they are of high contrast. Second generation reproductions should not require repeated half-tone screening.

Reproduced lines should be no less than .005 thick. Art that is drawn 50% larger than their reproduction should use 1/64 minimum lines. Strippling should not be used for shading.

Thick weight lines on drawings should be used for shadowed areas. Thinner lines are used for areas that receive light. Silhouetting with heavy lines and using thin lines for interiors are permissable.



5-2. Reflected Light

Reflections off of rounded surfaces form lines. These should be drawn in series of mixed short and long dashes. The space between dashes is also varied.

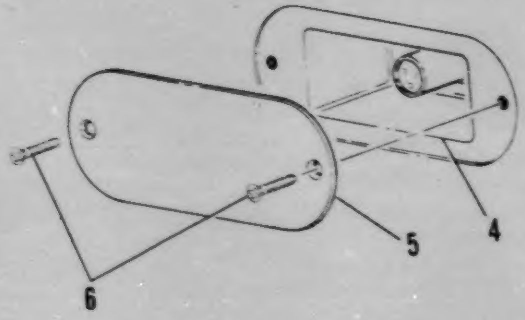
Any reflected light off of glossy surfaces form bright areas and lines. They often give detailed surface characteristics. Do not drop them.

NOTE

Reflected lines are nicknamed "nonelines."

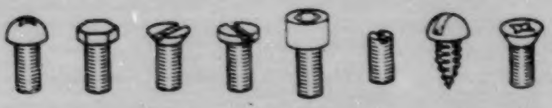
5-3. Overlaying Features

Overlaying features shall be well defined. This is done by breaking cross under lines 1/128 to 1/16 inches from overlaying features. Confusion to what bunts together or passes over/under is avoided.



5-4. Threads & Helixs

Screw threads and helixs should not fill in when reproduced. A reflected white line is used to avoid ink fill-ins. It is stripped in on the side receiving light.

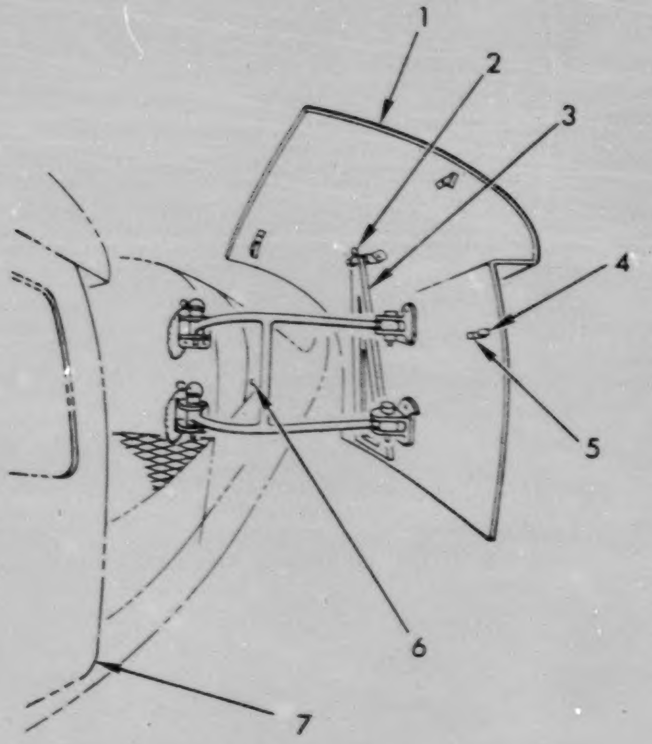


5-5. Lighting Angles

Light should come from the right side at a 45° angle. This is the normal lighting for axonometric drawings. Light for all "bird eye" views is from the top right side.

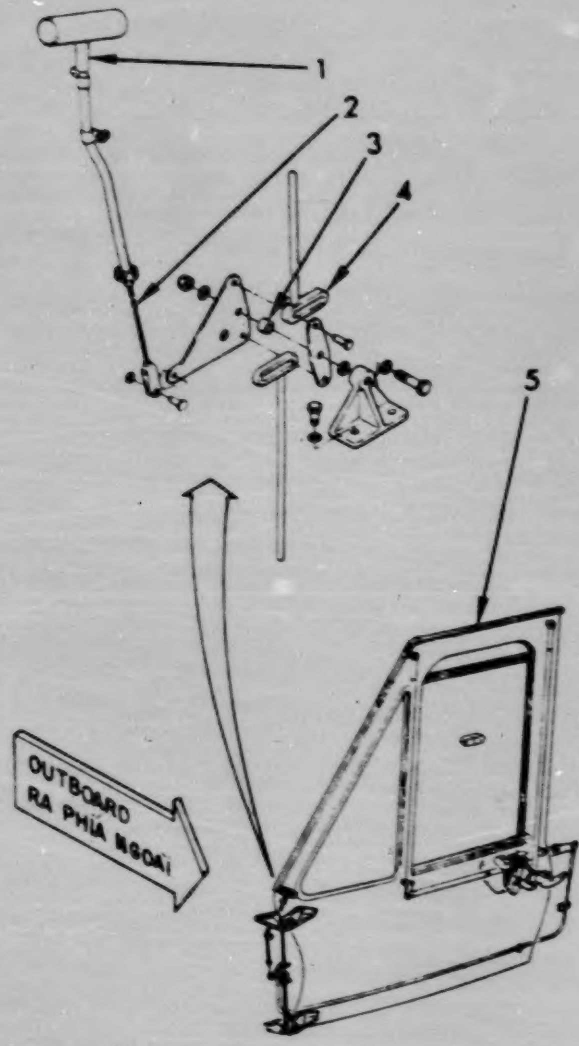
Views from the bottom are lighted from the bottom left.

Care should be taken to light illustrations as they would be in "real life." Perspective drawings are lighted naturally.



5-6. Details, Viewing, & Locations

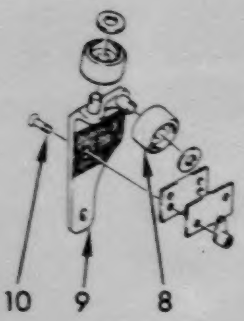
Confusing details should be dropped from illustrations. Focalizing on key information or hardware is most important. Phantom lines are used to give orientation.



Views seen while performing tasks should be used. Rotations from these normal viewing angles should be given on the illustrations.

A locator illustration is used to identify items within a system. Detailed items will be located with the over view. Swooping arrows are drawn from the silhouetted location to the items.

5-7. Exploded Views



Parts on an exploded view are aligned on center lines. These center lines are drawn to item locations. The actual locations and order of assembly are shown.

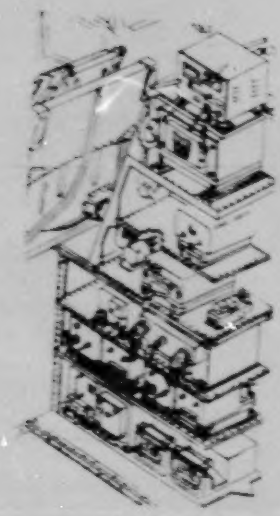
Care must be taken to show jigs or other holding devices. Warnings must be given if items are spring loaded. Holding methods shall be given as the first steps for disassembly.

5-8. Drawings From Photographs

Effortless tracings to form line drawing are made from photographs. Photographs must be taken from the right viewing angle. They may not be used if the angle is wrong.

A little time taking photographs can save many hours. Hang items from wires or brace them up before shooting. Use stepladders or lay on floors to get right angles.

Cropped blowups may be used. Close-ups often distort realistic views. Be very careful that all details are in focus.



5-9. Illustrating Prototypes

Very often manuals must be prepared before products are completed. The illustrations must then be projected from engineering drawings.

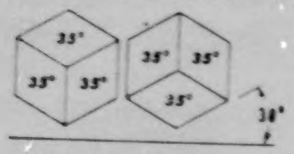
The angle of viewing must be from the performer's vantage point. Tasks done on workbenches can be axonometricly drawn. "Bird's-eye" views are used.

There are four types of axonometric drawings:

1. Isometric projections have one vertical and two 30° horizontal axis.
2. Oblique projections are orthographically projected faces with receding views.
3. Dimetric projections have one vertical scale with two equal (but not 30°) horizontal axis scales.
4. Trimetric projections have all three axis at different angles with different scales for each.

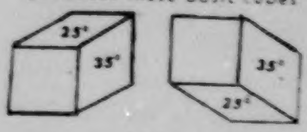
ISOMETRIC

produces these basic cubes


35°
35°
35°
35°
35°
35°
30°

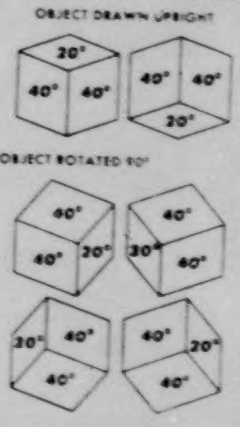
OBLIQUE

produces these basic cubes



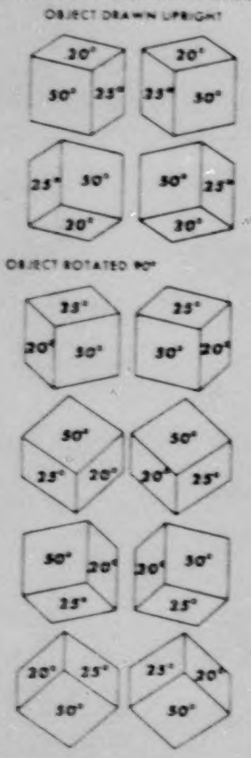
DIMETRIC

produces these basic cubes


OBJECT DRAWN UPRIGHT
20°
40°
40°
40°
40°
20°
OBJECT ROTATED 90°
40°
40°
20°
40°
30°
40°
20°
40°
40°
40°
20°
40°

TRIMETRIC

produces these basic cubes


OBJECT DRAWN UPRIGHT
20°
30°
25°
20°
25°
30°
25°
30°
20°
30°
25°
20°
OBJECT ROTATED 90°
25°
20°
30°
25°
30°
20°
50°
25°
20°
50°
20°
25°
50°
20°
25°
20°
30°
25°
20°
25°
30°
25°
20°
30°

5-10. Oblique and Isometric Projections

Tasks seen from frontal positions can be drawn obliquely. The face is drawn parallel to the horizontal and top and side views are projected.

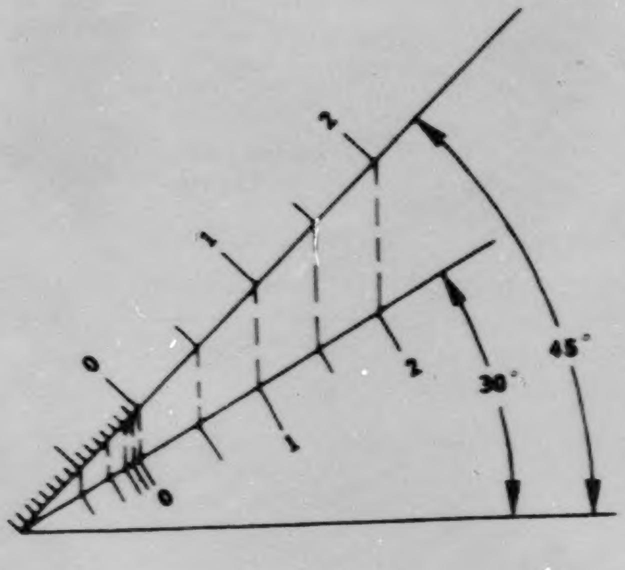
Isometrics are classified as follows:

1. Cavalier projections use the same scales on all three axis.
2. Cabinet projections have receding lines foreshortened to their face, scale by half or greater.
3. General projections do not foreshorten receding lines by more than half and are usually full scaled.

NOTE

There is a difference between drawing and projected scales. Drawings use ordinary engineering or architectural scales. Projections use axonometric projected scales.

Isometric projections should be restricted to workbench tasks. This is because of the illusion to high viewing positions. The isometric projection scale is made as follows:



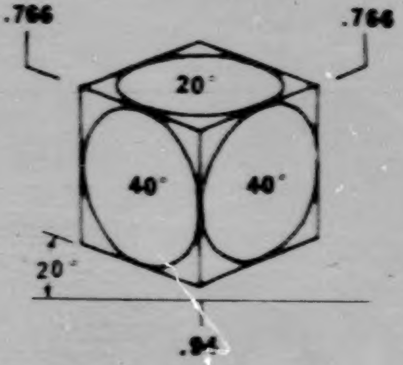
1. From a horizontal line lay two angled lines. One at 45° and the other at 30°.
2. Place an architectural or mechanical engineering drawing scale on the 45° line.
3. Transfer the scale to the 45° line.
4. Draw 90° vertical lines down from the marked scale to the 30° line.

5. Transfer the scale produced on the 30° line to a convenient strip.

6. Use the strip as a scale.

NOTE

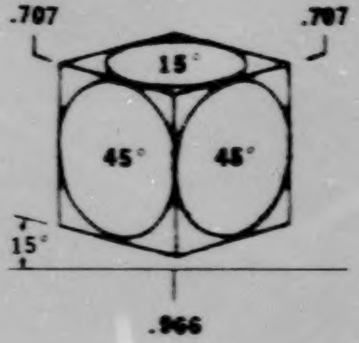
Standard 35° ellipse templates are used for circles on all faces. Mathematically 35° 15' is the actual projected ellipse.



5-11. Dimetric Projections

Dimetric drawings use two scales. One is for the vertical lines. The other two axis use a different scale.

There are two popular projections. One has the front and side planes using 40° and top using 20° ellipses. The other uses two 45° and one 15° ellipses. Scale projections and other construction information are given in the illustrations.



5-12. Trimetric Projections

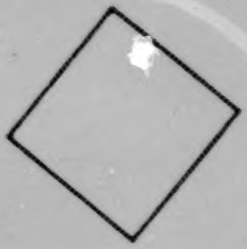
Trimetric projections give realistic appearance. The variety can only be matched by perspectives. Each of the three axis has its own scale.

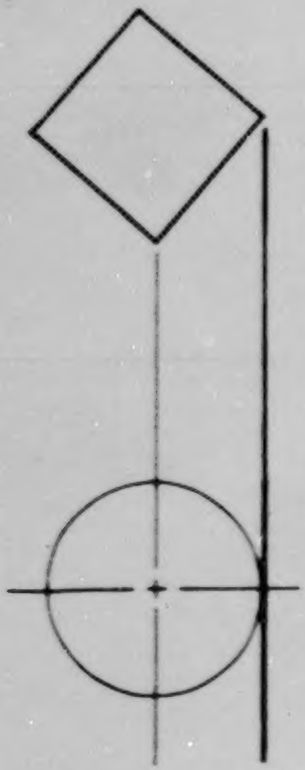
Their angle of views require the development of their own specialized scales.

1. Measure off in convenient segments an orthographic cube.

2. Turn the cube on a vertical axis.

3. Isolate the top view.



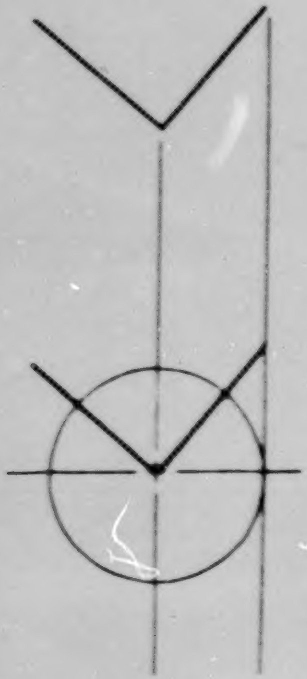


STEPS 4-6

4. Draw a vertical center line.

5. Draw vertical lines from the nearest leading edge.

6. Inscribe a circle from the center line to the leading edge line.



STEP 7

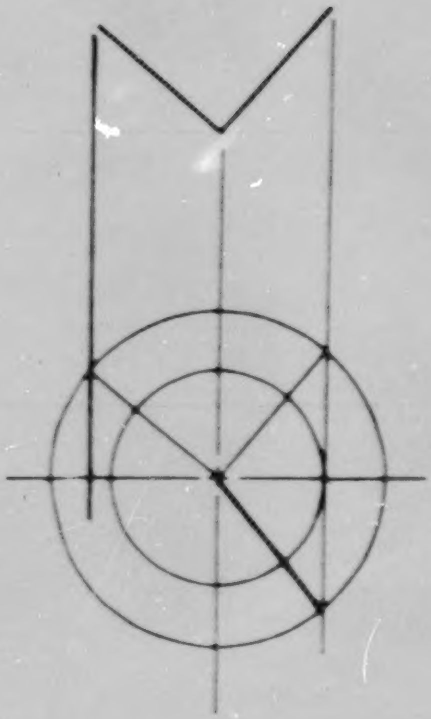
7. Draw lines from the center point parallel to the horizontal angles of the leading edges.

8. Vertically project a line from the outside edge.

9. Inscribe a second diameter that touches the second vertically projected edge. Then draw third line to center.

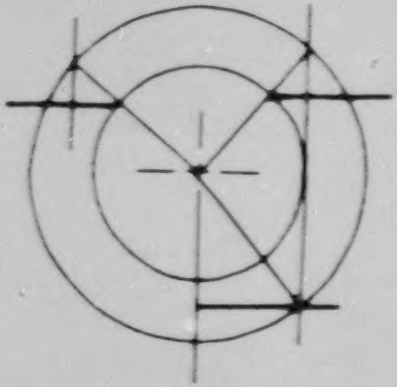
NOTE

The diameter will always be twice the size as the increment of measurement. A one inch cube will have a two inch outside diameter.



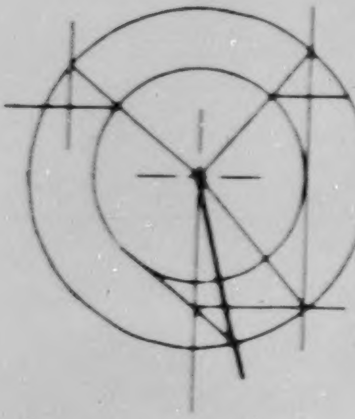
STEPS 8-9

10. Draw three short horizontal lines (two from the points created on the smaller diameter in steps 7 thru 9 - one from where the projected object line in step five is tangent to the smaller diameter and dissects the larger diameter).

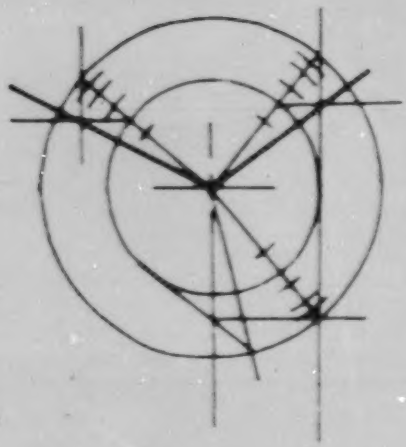


STEP 10

11. Draw a line tangent to the smaller diameter crossing the center line (which is always between the two diameters) to cross the larger diameter.



STEP 11

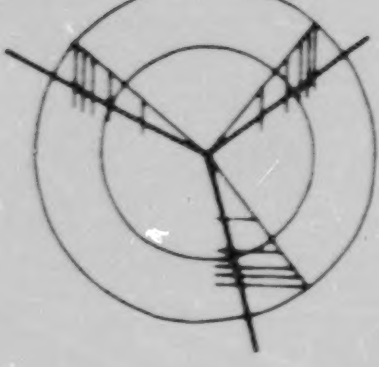


STEPS 12-14

12. From the point on the larger diameter (created by step 11) project a line to cross the center points of diameters.

13. Inscribe the full scales on the lines created by steps 7 and 12.

14. Draw two lines from the center of the diameter to cross the points created in steps 5, 8, 9, and 10.



STEPS 15-16

15. Project vertical lines from the scales in steps 7 and 13.

16. Draw horizontally from the scales created in step 13 onto the line of step 12.

17. Transfer the scales created on the lines of step 14 and the center line.

The transferred scales on strips are then used to make trimetricly projected drawings. This method gives an endless number of viewing positions.

NOTE

Either bird's-eye or worm's-eye views are developed with the same set of scales. For worm's-eye view step 3 isolates the bottom instead of the top.

The scale lines of 17 become the three axes of diagonal planes. Rocking or angle edges should be produced to maintain constant degrees. These edges are in turn placed against horizontal straight edges.

5-13. Axonometric Ellipses

True lengths on the major ellipses axis are not reduced by the projected scale. The minor axis is always reduced in direct proportion to the perpendicular scale of the plane axes. The perpendicular axis also becomes the minor axis of the ellipse.

NOTE

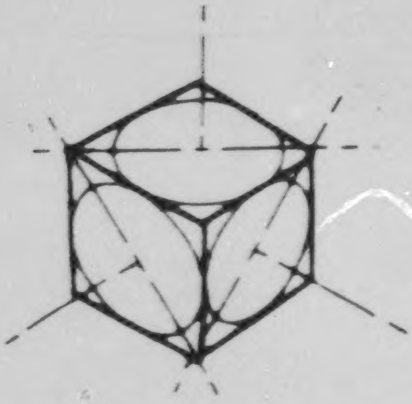
> Trigonometric function charts are found in most drafting and engineering text books. Many calculators have built-in trigonometric functions.

The mathematic formula is:
T - Pt = C

T = True length

Pt = Projected difference as compared to true length

C = Cosine of the projected plane and its ellipse.

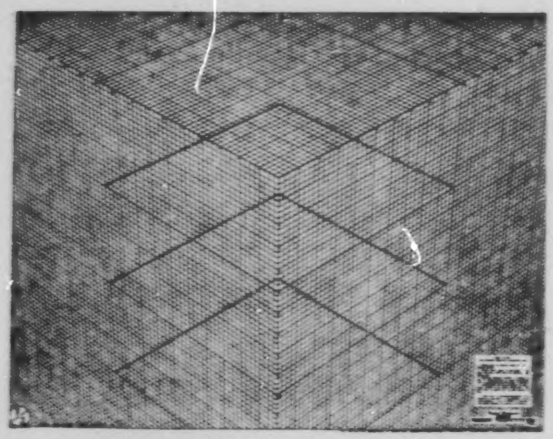


Ellipses using formula in 5-13.

The projected length is measured with a true length scale. The true length scale must be one that is divided into decimal increments.

NOTE

> Projected scales divided into 16th or 12th must be converted into hundredths. The scale that is easiest to use is the 50th scale. Each mark then represents increments of two tenths.

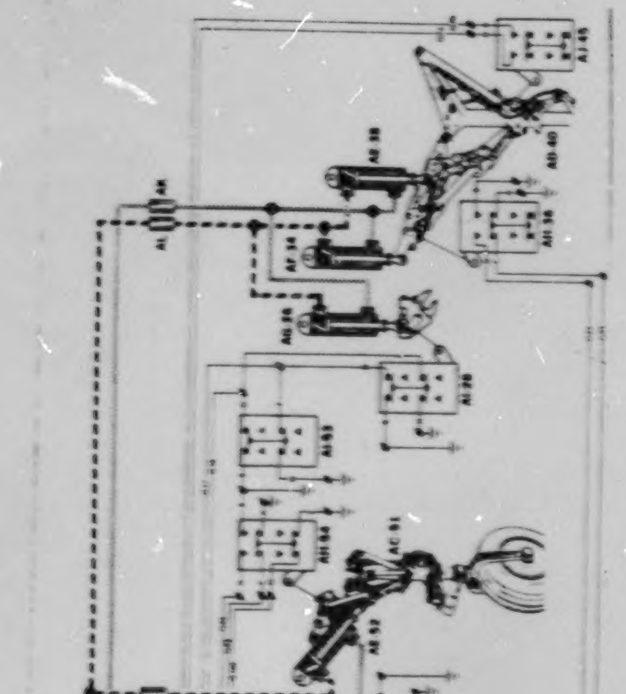


5-14. Perspective Drawings to Scale

Projection from engineering drawings (blueprint) is the only way to be sure of correct perspectives. Hardware should be done in this manner. Direct projection of the item can be used or just a projected scale used.

Projected scales can be purchased as guides. There are also perspective drawing boards and special drafting machines with built-in scales. These all use the geometric principle of measuring on X, Y, and Z datums.

There are one, two, three, and multi point perspectives. These would take more space to discuss than what can be devoted to the subject here. Text books on perspective projection should, therefore, be sought.



5-15. Flow Diagrams

Flow charts are often hard to read. The flow diagram should be substituted whenever possible. Pictures of hardware or pictorial symbols are used instead of block diagrams.

5-16. Typography Requirements

The following is a list of requirements:

1. Security Classification - 14 pt Extra Bold - Caps only
2. Figure Title (if any) - 12 pt Extra Bold Sans Serif - Caps only
3. Illustration Orientation - 12 pt Extra Bold Sans Serif - Caps only
4. Call Out Numbers - 18 pt Extra Bold Sans Serif - Caps only
5. Schematics and Diagrams - 18 pt Extra Bold Sans Serif - Caps only
6. Paragraph Headings & Numbers - 18 pt Extra Bold Sans Serif - Caps only
7. Keyed Text - 18 pt Extra Bold Sans Serif - Caps only
8. Section Titles - 10 pt Futura Light - Caps only
9. Notes, Caution, and Warning Titles - 10 pt Futura Light - Caps only
10. Text of Notes, Cautions, and Warning - 10 pt Futura Light - Upper and Lower Cases
11. Text Body - 10 pt Futura Light - Upper and Lower Cases
12. All other written matter - 10 pt Futura Light - Upper and Lower Cases

Special care is used when copy reproduction appears in both small and large formats. Camera ready copy need only be prepared once. The large format is used and the typography increased by two points.

NOTE

Arrangements for such dual reproduction should be worked out with Oklahoma City ALC/MMS.

Printing cost savings should be sought in all reporduction. Typography requirements should be adjusted when required. These can only be approved through AFLC DCS/Materiel Management's Directorate of Service Engineering.

5-17. Page Sizes

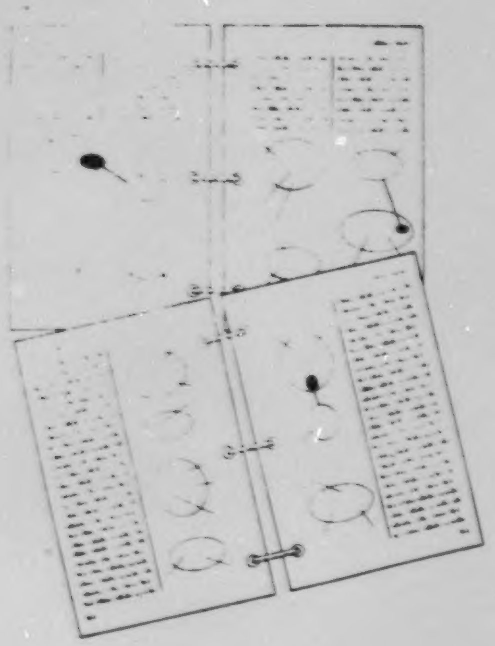
Large formatted pages are 8 1/4 x 10 3/4 inches. Text with illustration areas starts one inch from center of a two page spread. Area is 7 x 9 1/2 inches.

Small formatted pages are 5 x 7 3/4 inches. Text with illustration area starts 3/4 inch from center of a two page spread. Area is 4 x 6 1/4 inches.

Classifications, publication numbers, and page numbers are outside text and illustration areas. These are 5/8 on the large and 3/8 on the small formats. Both are three ring or spiral bound.

NOTE

Examples of individual page formats are found in AFHRL-TR-73-43(1) Report. Further guidance is given in MIL-M-38800 and 38730. T.O. 00-5-1 gives information on the Air Force's technical order system.



PAGE LAYOUTS

AD HOC OF THE JOB PERFORMANCE AID

SECTION 6

6-1. Insularity

Personnel and technology combined have rapid turnovers. Subtractions, additions, throw aways, newer developments are maintained or dropped by transient activities. Trained today, retrained tomorrow - station here, moved to there - dropped functions, changed requirements call for ad hoc resolvements.

Technical manuals and training are reduced to insularity. Information used by personnel who have never done "that given task" must be easily followed. The JPA becomes an informative island.

Tasks that are repeated occasionally should require refreshment only by experienced performers. The same tasks may be repeated but not always done by the same individuals. These two facts are incorporated in the JPA and becomes a hallmark.

6-2. Task Forces and Project Teams

The permanent divisions of tasks assigned personnel have been lost. The skilled supervisor and the newly assigned personnel often do the same tasks.

Task forces are organized around a system or subsystem. These are actual hardware or organizational functions. Task forces may be long or short termed, stationary or mobile.

Task forces are usually marked by their life span or their rapid turnover of personnel. The given task may be the changing factor. Ad hoc activity is the inherent factor in preparing JPAs.

6-3. Ad Hoc in Manuals, Training and Products

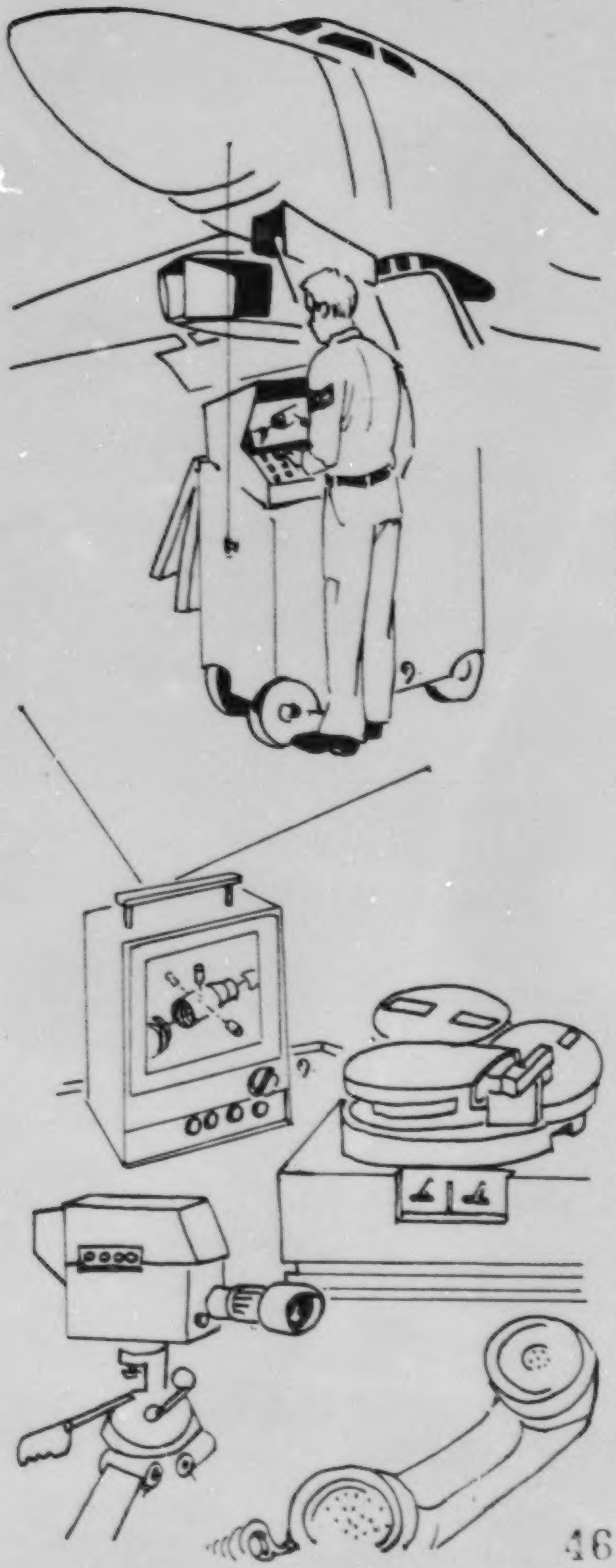
1. Manuals must be written so that a task may be done by performers.

2. Training must consist of psychological orientation and confidence.

3. JPA task forces are organized transients (as well as their products for sole purposes).

Job Performance Aids are prepared for ongoing transitory needs. They are prepared by task forces that change staff, locations, and subjects. The imparted knowledge may be used once before the task is changed, deleted, or personnel replaced.

The JPA efforts will fail its full potential unless ad hoc requirements are met. Adaptability in task performance is sought. Singleness of purpose is directed at sole demands.



6-4. Knowledge Gathering and Distribution

Information about a given task should be sought from the originators and performers. It means going to the point of manufacturing. Continuous feedback and updating by and for the performers should be maintained.

The Job Performance Aid is a total concept of training, guiding; and updating. It means preparing audio visual aids, programmed learning courses, and job guide manuals. Production must be constantly updated and improved.

Distribution of the JPA can be done by having them accompany products they support. A record of product locations can aid in delivery of updated data. Electronic communications can furnish means for constant feedbacks and updates.

6-5. JPA Feedback Systems

Feedback to the preparing activity can be maintained through training methods. The JPA lends itself well to programmed learning techniques. Tests and/or work sheets can be retrieved from students and used as feedback.

Product experts using Wide Area Telecommunication Services (WATS) can dispense answers to task performers. These inquiries show weaknesses in or need for modifications of the JPA. Updates can then be made and delivered to all users.

Videotape and closed circuit communications can be used in the future as JPA flow systems. Performers follow the steps on TV monitors, stopping the recorder between steps. Questions that become feedbacks are asked of experts by using phones, radios, or combinations with video cameras.

6-6. Formal Training

The JPA spells out task steps. Following these steps should be easy. Formal training must then be confined to psychological preparedness.

The student performer is taught the use and feel of tools, equipment, and supplies. The JPA would be bulky if these kinds of descriptions had to be fully given.

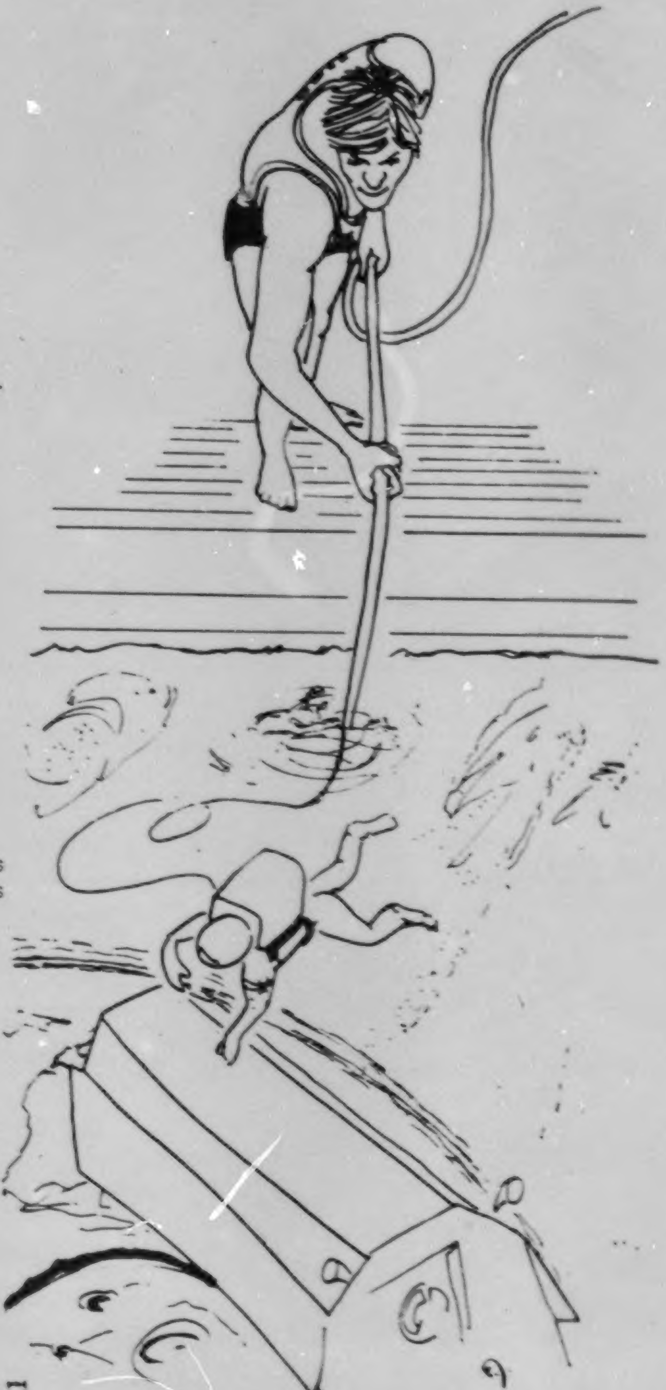
The ad hoc JPA becomes the extension of collective thought. The performer must be willing to mentally join the link. Emotions are a part of job performance.

6-7. Orientation Training

Environmental orientation is the packaged experience that allows performance. Training JPAs should be used to bridge the gap between the familiar and the unfamiliar.

These bridges can be films. Sometimes field trips or classes in environments help. Simulators, models, and diagrams are used to transport environments.

Artificial surroundings can use sound, touch, smell, as well as sight to environmentally orientate. Realism by electronic communications and computer programming also can aid. These then become "psych-corp" JPAs.



NOTE

More information about psych-corp art in Section 2, Item 3.

6-9. JPAs Prepared by Single Staff Members

One person can prepare Job Performance Aids. The individual should have experience in one or more disciplines. These would be as a communication artist, psychologist, educator, statistician, scientist, engineer, and writer.

The individual would have to call upon others in different disciplines for contributions. The approach would be to staff ad hoc committees. The authority for quickly formulating committees would be the individual's privilege.

The assignment lasting only until the JPA is completed. Preparing a JPA may be dual with other ongoing responsibilities.

NOTE

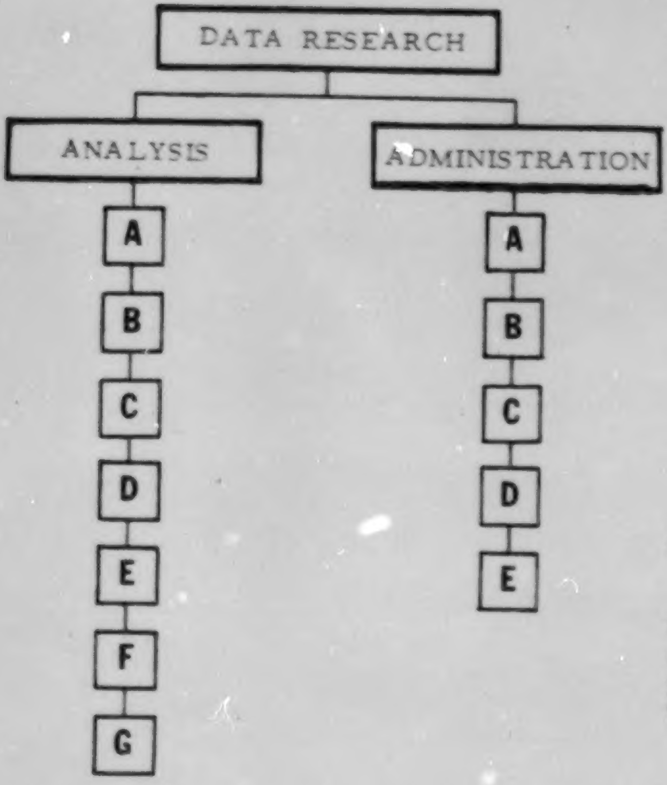
> The nature of the JPA calls for undivided attention. Other tasks should ideally be held in abeyance.

6-10. Skill Areas Used in Preparing JPAs

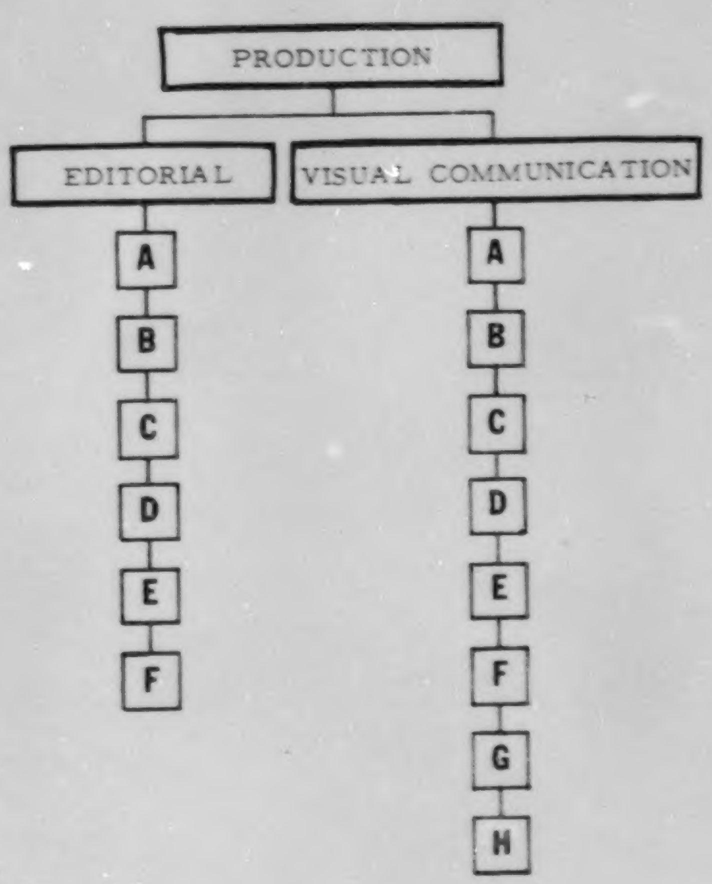
Skills called upon fall into two major areas. These are data research and production. These are further reduced to:

1. Data research
    a. analysis
    b. administration
2. Production
    a. editorial
    b. visual communication

These in turn can be further specified in terms of skills:



1. Analysis
    a. systems engineering
    b. specialized engineering
    c. scientific
    d. technical
    e. analytical
    f. statistical
    g. psycological
    h. task execution
2. Administration
    a. personnel management
    b. accounting
    c. supply
    d. computerization
    e. office function
3. Editorial
    a. technical writing
    b. speech writing
    c. copy research
    d. speaking
    e. educational
    f. printing
4. Visual communication
    a. illustrative
    b. drafting
    c. artistic (sculpturing, modeling, music, acting, etc.)
    d. paste-up
    e. video
    f. photographic


PRODUCTION
EDITORIAL
VISUAL COMMUNICATION
A
B
C
D
E
F
A
B
C
D
E
F
G
H

g. typography

h. fabrication

Many of these skills cannot be staffed. Ad hocing the required skills for short time spands will work. Required preparing skills will change with JPA formats like:

1. programmed learning aids
2. environmental orientation aids
3. audio visual aids
4. troubleshooting aids
5. job guide aids
6. on-line communication aids

6-11. Diversified Ad Hocary

It is because of the many diversified skills needed that ad hoc is advocated. The usually short time frames for completion dictates ad hoc. The shifts of JPA subjects and formats makes ad hoc a reality.

Ad hoc has become a life style, a technological fact. It has developed into special kind of art medias.

Here it is advocated as a communication tool.

Ad hoc will allow development of task pictured communications. It can be used to keep that communication updated. The JPA follows the same patterns of their subjects (from new, replacement, to throw aways).

VERB LIST

VERBS FOR USE IN JOB PERFORMANCE AIDS FOR AIRCRAFT MAINTENANCE & PACKAGE ENGINEERING

The following verbs are defined in terms associated with aircraft maintenance and package engineering. An example sentence is provided for each verb. It is not intended that verbs used in the preparation of JPAs be limited to those listed in this guide. The verb list is neither complete nor are all possible meanings of the verbs given. Only the most basic meanings are given to aid understanding by field personnel with set reading skills. It will aid readers of JPAs to scan read--a very important element in performing tasks described in those publications.

The number listed in the preference rank column is the standing in a comprehensibility range of the verb as compared to other of its synonyms. In addition, the synonyms, where possible, are listed by reading ability. An adult with a fifth grade reading ability will not have trouble with verbs ranked as one (1). Higher numbered synonyms should be used when the first ranked verb is particularly awkward or misleading. In general, the order of preference will be 1, 2, 3 and so on until the synonyms are exhausted. It should be noted that departures from the list may cause problems with continuity and reading skills. The intended purpose of JPA writing can be accomplished if the writer uses simple verbs.

The auxiliary verbs are not listed.

At the time of publication this list was being revised. It was felt that the value in having the information contained in the total report was such that the project of revision should be a separate effort.

VERBS FOR USE IN JOB PERFORMANCE AIDS FOR AIRCRAFT MAINTENANCE & ENGINEERING PACKAGING

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Accomplish	To do, carry out or bring about; to reach an objective.	Accomplish an inspection of all humidity indicators	2	1. Perform 3. Effect	
Actuate	To put into mechanical motion or action; to move to action.	Actuate the hand pump until the pressure gauge indicates 3000 psi.	-		
Adapt	To make fit a new situation or use, often by modifying.	Adapt the container to a 3/4 inch opening.	2	1. Trim	
Add	To put more in.	Add water to the battery.	-	2. Increase	
Adhere	To stick together; to cause two surfaces to be held together by adhesion.	Adhere the tape to the corrugated board.	4	1. Stick 2. Glue 3. Attach 5. Bond	
Adjust	1. To bring to a specified position or state.	1. Adjust the micrometer to the given measurements.	2	1. Improve 3. Zero	
	2. To bring to a more satisfactory state; to manipulate controls, levers, linkages, etc., to return equipment from an out-of-tolerance condition to an in-tolerance condition.	2. Adjust cable tension using the turnbuckles.	1	2. Trim 3. Change	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Advance	To move forward; to move ahead.	Advance the throttle.	-		
Advise	To give information or notice to.	Advise man B that the brakes have been set.	4	1. Report to 2. Inform 3. Notify 5. Communicate to	
Agitate	To move with a jerky, quick, or violent action.	Agitate the container so that the paint will be well mixed.	2	1. Shake	
Aid	To give help or support to; to assist.	Aid man B to lift the load.	3	1. Assist 2. Help	
Alert	To warn; to call to a state of readiness or watchfulness; to notify (a person) of an impending action.	Alert personnel that area will be cleared.	-		
Align	To bring into line, to line up; to bring into precise adjustment, correct relative position or coincidence.	Align slot in turnbuckle barrel with slot in cable terminal.	-		
Allocate	To apportion for a specific purpose or to particular persons or things.	Allocate the various maintenance tasks to technicians.	3	1. Assign 2. Distribute	
Allow	1. To permit, to give opportunity to.	1. Allow the sediment to settle out.	1	2. Let	
	2. To allot or provide for.	2. Allow a 2 inch slack in the rope.	1	2. Leave	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Alternate	To perform or cause to occur by turns or in succession.	Alternate between pilot's and copilot's instrument test.	-		
Analyze	To examine and interpret test or inspection results to determine system or equipment condition or capabilities.	Analyze engine inspection findings to determine need for repairs.			
Angle	To turn, bend, move, or cut at an angle or in angles.	Angle the box so it will drop on its side.	1	2. Bevel 3. Chamfer	
Apply	1. To lay or spread on.	1. Apply sealant to gap.	1	2. Put 3. Lubricate	Use "lubricate" rather than "apply lubricant."
	2. To energize.	2. Apply power or load.	-		
Arrange	To group according to quality, value or other characteristics, to put in proper order.	Arrange components by size from smallest to largest.	1	2. Order	
Ascertain	To find out with certainty that a proper condition exists.	Ascertain that the light is off.	5	1. Be sure 2. Verify 3. Check 4. Determine	
Assemble	To fit and secure together the several parts of; to make or form by combining parts.	Assemble a jet engine in accordance with specified procedures.	1	2. Construct	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Assess	To determine the importance, size or value of; to evaluate.	Assess the success of the maintenance action.	2	1. Evaluate	
Assign	To apportion to for a specific purpose or to particular persons or things; to appoint to a duty.	Assign the various maintenance tasks to technicians.	1	2. Distribute 3. Allocate	
Assist	To give support or help; to aid.	Assist man B to lift the antenna.	1	2. Help 3. Aid	
Assure	To make someone sure or certain, to inform positively.	Assure other technicians that all warning lights are off.	-		
Attach	To fasten by sticking, tying, etc.	Attach eletrical leads to the multimeter.	3	1. Stick 2. Glue 4. Adhere	Use "tag" in preference to "attach" a tag.
Back off	To cause to go in reverse or backward.	Back off nut to the nearest castellation.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Bake	To dry out by heating the solvent in a coating applied to a sheet or container. To resolvent and cure by heating an enamel or lacquer applied to a sheet or container.	Bake the enamel to the surface of the board.	2	1. Dry out 3. Scorch 4. Parch	
Balance	To equalize in weight, height, number or proportion.	Balance aircraft so that it is stable.	-	Equalize	
Be careful	To exercise caution, to take care.	Be careful not to inhale the fumes of the solvent.	-	Avoid inhalation of	
Be sure	To confirm that a proper condition exists, to find out with certainty.	Be sure that the light is off.	1	2. Check 3. Determine 4. Verify 5. Ascertain	
Bend	To turn or force from straight or even to curved or angular, or to force, back to an original straight or even position.	Bend wire until it lies flat against the turnbuckle wall.	-	Fold	
Bevel	To form a sloping or slanting edge on a container or part.	Bevel the edge of the box so it will be easier to pour from.	2	1. Angle 3. Chamfer	
Bleed	To extract or let out some or all of a contained substance from.	Bleed off tank air pressure.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Blow	To send forth air, particularly from the lungs through the mouth.	Check for obstructions by disconnecting the hose at the air inlet and blowing through it.	-		
Bond	To attach materials together by adhesives.	Bond the paperboard box together with the gummed adhesive.	4	1. Join 2. Connect 3. Attach 5. Adhere	
Brace	To support, to make firm or rigid, to prop, or to strengthen.	Brace the box tightly, so it doesn't fall apart.	2	1. Support 3. Strengthen 4. Fortify	
Braid	To mix, weave, or entwine together.	Braid the wire to the inside of the electrical system.	2	1. Lace 3. Weave	
Break	1. To separate into parts with suddenness or violence.	1. Never break safety wire to release air pressure.	-		
	2. To pull away.	2. Break the bead of the tire.	-		
Buck	To reseat or tighten rivets from the shank side.	Buck rivets to stop the leak.	-		
Bump	To assemble two or more parts of a container between dies by means of the stroke of a press. To lock together the edges forming the side seam of the can.	Bump the edges together, so the seal is tight.	1	2. Knock 3. Strike	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Calculate	To determine by arithmetic processes.	Calculate the voltage in a circuit with 10 amps of current and 5 ohms of resistance.	1	2. Figure 3. Compute	
Calibrate	To determine accuracy, deviation or variation by special measurement or by comparison with a standard.	Calibrate torque handles at least once each month so that the accuracy can be depended upon.	-		
Cap	To provide with a covering; to install or provide with a device for closing off the end of a tube which has a male fitting.	Cap all lines which have exposed male fittings.	1	2. Tip 3. Install caps 4. Close off 5. Plug	
Care for	To take responsibility for the proper handling and upkeep of.	A mechanic cares for his tools.	-		
Cast	To form a shaped object by pouring a material into a mold and letting it harden without the application of external pressure.	Cast a mold to fit the shape of the tray.	3	1. Form 2. Mold 4. Preform 5. Die-cut	
Catch	To prevent from falling to the ground, to capture.	Catch any fluid drippings in a drip pan.	-		
Categorize	To put into categories or general classes.	Categorize components by their function.	2	1. Classify	For determining the classification of a supply item, use "identify."

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Cave in	To fall, in or down, as a result of undermining or of pressure from above; to collapse or submit.	Cave in the sides of the box to show its fragility.	1	2. Collapse	
Center	1. To adjust so that axes coincide.	1. Center the nose wheel of the aircraft.	-		
	2. To place in the middle of.	2. Center the pointer on the dial.	-		
Chamfer	To bevel; to form an angle.	Chamfer all of the edges of the container so as to make them easier to stack.	3	1. Angle 2. Bevel	
Change	To replace with another comparable item; to substitute serviceable equipment for malfunctioning, worn-out or damaged equipment.	Change the switch contact points.	2	1. Replace	
Channel	To form, cut, or wear a groove in.	Channel the rods so that they can be inserted easily.	-		
Charge	To restore the active materials in a storage battery by the passage of a direct current through in the opposite direction to that of the discharge.	Charge the battery for a short time before making a specific gravity check.	1	2. Cycle	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Check	1. To confirm or establish that a proper condition exists; to ascertain that a given operation produces a specified result; to examine for satisfactory accuracy, safety or performance; to confirm or determine measurements by use of visual or mechanical means.	1. Check that the light is off.	3	1. Be sure 2. Verify 4. Determine 5. Ascertain	
	2. To perform a critical visual observation or check for specific conditions; to test the condition of.	2. Check the components for wear, deterioration or defects.	3	1. Inspect 2. Examine 4. Zero	
Checkout	To perform specified operations to verify operational readiness of a subcomponent, component, subsystem, or system.	Checkout the landing gear.	1	2. Test	
Chock	To place a blocking device, designated by the Air Force as a chock, adjacent to, in front of, and behind to keep from moving.	Chock main and nose landing gear wheels.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Choke	To enrich the fuel mixture of a motor by partially shutting off the air intake of the carburetor.	Choke engine as required to start.	-		
Choose	To make choice of; to select, decide.	Choose the best corrugated board for the use of stacking.	1	2. Select 3. Cull	
Clamp	To fasten or press two or more parts together so as to hold them firmly.	Clamp the tensiometer to the cable by releasing the handle slowly.	-		
Clasp	To surround and cling to, grasp by encircling.	Clasp the board in the vice to test its durability.	1	2. Duck-in	
Classify	To put into categories or general classes.	Classify components by their function.	1	2. Categorize	For determining the classification of a supply item, use "identify."
Clean	To wash, scrub or apply solvents to; remove dirt, corrosion or grease.	Clean petroleum products from oxygen equipment.	-		
Clear	1. To move people and/or objects away from.	1. Clear the area.	-		
	2. To open the throttle of an idling engine to free it from carbon.	2. Clear the engine.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Clinch	To bend or crimp an edge of plate about another part and press it down firmly so as to fasten the two together; to bend the protruding points of nails.	Clinch the corner of the box.	2	1. Clamp 3. Secure 4. Crimp	
Clip	To fasten together with a clip, to cut corner folds with scissors in making set up paper boxes.	Clip the flaps together to form the bottom of the box.	3	1. Cut 2. Trim 4. Shear	
Close	1. To block against entry or passage; to turn, push or pull in the direction in which flow is impeded.	1. Close the valve.	-		
	2. To set a circuit breaker into the position allowing current to flow through.	2. Close the circuit breaker.	-		
Coat	To cover or spread with a finishing, protecting layer.	Coat battery cables with grease.	-		
Code	To put into the form or symbols of a system used to represent words; to mark with identifying symbols.	Color code equipment parts.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Collapse	To suffer collapse; to cave-in.	Collapse of the package was due to extreme water pressure.	2	1. Cave-in 2. Yield	
Collect	To bring together into one body or place; to accumulate.	Collect the required hand tools.	-		
Communicate	1. To exchange information.	1. Communicate with man B during the entire procedure.	-		
	2. To make known.	2. Communicate to man B that the brakes have been set.	5	1. Report to 2. Inform 3. Notify 4. Advise	
Compare	To examine the character or qualities of two or more items to discover resemblances or differences.	Compare the readings from protractor and template.	-		
Compile	To compose or put together out of materials from several sources.	Compile the records of all maintenance on the specified aircraft.	-		
Comply	To conform with directions or rules; to accept as authority, to obey.	Comply with directions.	2	1. Follow	
Compress	To squeeze together, to condense.	Compress the forward and aft sections of the hydraulic pitch lever.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Compute	To determine by arithmetic processes.	Compute the voltage in a circuit with 10 amps of current and 5 ohms of resistance.	3	1. Calculate 2. Figure	
Condition	To put into a proper state for work or use.	Condition components before installing them.	-		
Conduct	To lead, manage or direct.	Conduct the class in proper servicing procedures.	-		
Confer	To consult; to exchange views.	Confer with maintenance supervisor if necessary.	-		
Connect	1. To bring or fit together so as to form a unit, to couple keyed or matched equipment items.	1. Connect the antenna cable to the radio transmitter.	3	1. Tag 2. Bond 4. Attach 5. Mate 6. Join 7. Unite 8. Splice 9. Stitch 10. Hinge	
	2. To attach or mate (an electrical device) to a service outlet.	2. Connect the soldering iron to the service power outlet.	2	1. Plug in	
Consolidate	To join together into one whole; to form into a compact mass.	Consolidate contents of both containers.	-		
Construct	To make or form by combining parts; to fit and secure together the several parts of.	Construct a jet engine in accordance with specified procedures.	2	1. Assemble	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Control	To exercise restraining or directing influence over, to fix or adjust the time, amount or rate of.	Control electrical current generation and distribution.	2	1. Regulate	
Coordinate	To bring into a common action, movement or condition.	Coordinate the activities of man B and man C.	-		
Copy	To make an imitation, transcript or reproduction of.	Copy the tail number on the record form.	-		
Correct	To make or set right, to alter or adjust so as to bring to some standard or required condition.	Correct any error before proceeding with activity.	-		
Cover	To protect or shelter by placing something over or around.	Cover tires whenever maintenance is done on the aircraft.	-		
Crack	To open slightly (the throttle) of an aircraft engine preparatory to starting the engine.	Crack and lock the throttle to 1/8 open.	-		
Crease	To form a crease in a sheet of any material usually for the purpose of providing a bending line.	Crease the box properly so that they may be stacked.	3	1. Fold 2. Seam 4. Crimp	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Crimp	To fold in, squeeze or tighten by a series of corrugations so as to hold one part against another.	Crimp the papers so they will roll properly.	5	1. Clamp 2. Clinch 3. Secure 4. Crease	
Cull	To select, sort or pick out defective parts or articles not meeting up to standards.	Cull all the inefficient parts from the shelf.	4	1. Sort 2. Choose 3. Select	
Cure	To treat a material by some application to impart desired physical characteristics for a specific use.	Cure the paper properly so it is not deficient in any way.	-		
Cut	To divide into parts using a sharp instrument such as a scissors or knife.	If the prongs of the cotter pin are too long, they should be cut to proper length.	-		
Cycle	To charge (a battery) for a short time.	Cycle the battery before making the specific gravity check.	2	1. Charge for a short time.	
Deflate	To release air or gas from.	Deflate the shock strut to check fluid level.	-		
Deflect	To move aircraft control surfaces (elevators, ailerons, etc.) to a position different from the major axes of the aircraft.	Deflect the surface upward to the mechanical stops.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Dehumidify	To dry out or absorb moisture by means of baking, ventilating, or by the use of a dessicant.	Dehumidify the chamber.	2	1. Dry 3. Dehydrate	
Dehydrate	To deprive of, or to lose water; to dry completely.	Dehydrate the chamber before putting the specimen inside.	3	1. Dry 2. Dehumidify	
Deplete	To lessen markedly in quantity, content or power.	Deplete system pressure.	-		
Depress	To press or push down.	Depress both brake pedals.	-		
Depressurize	To release gas or fluid pressure from.	Depressurize the hydraulic system.	-		
Destroy	To ruin, demolish or put out of existence; to make unfit for further use.	Destroy used hydraulic fluid containers.	-		
Detect	To discover or determine the existence, presence or fact of.	Watch very carefully so as to detect any needle movement.	-		
Determine	1. To obtain definite and first-hand knowledge of, to conform or establish that a proper condition exists.	1. Determine that the light is off.	4	1. Be sure 2. Verify 3. Check 5. Ascertain	
	2. To investiage and decide to discover by study or experiment.	2. Determine the amount of tension on a cable by following specified procedures.	1	2. Find	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Develop	To set forth or make clear by degrees or in detail.	Develop procedures fully.	-		
Devise	To form by new combinations or applications of ideas or principles; to invent.	Devise new methods of troubleshooting the system.	-		
Diagnose	To recognize and identify the cause or nature of a condition, situation or problem by examination or analysis.	Diagnose the malfunction.	-		
Die-cut	To punch out with a sharp tool.	Die-cut the foam so as to make a cushion.	5	1. Form 2. Mold 3. Cast 4. Preform	
Dimension	To measure, to indicate with dimensions as a drawing of architecture.	Dimension that piece of equipment so as to properly acquire all the necessary parts.	3	1. Size 2. Measure	
Dip	To immerse for a short period of time.	Dip the film into the acetone to see if it will become flexible.	1	2. Immerse 3. Submerge 4. Douse	
Disassemble	To take to pieces; to take apart to the level of the next smaller unit or down to all removable parts.	Disassemble the No. 1 engine.	1	2. Dismantle (For opposite, see Assemble)	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Disconnect	1. To sever the connection between; to separate keyed or matched equipment parts.	1. Disconnect the bleed air hose from the leading edge anti-icing system.	-		
	2. To detach or separate (an electrical device) from a service outlet.	2. Disconnect the soldering iron from the service power outlet.	2	1. Unplug	
Disengage	To release or detach interlocking parts, to unfasten; to set free from an inactive or fixed position.	Disengage the parking brake.	2	1. Release 3. Unlock	For circuit breaker, use "open."
Dismantle	To take to pieces; to take apart to the level of the next smaller unit or down to all removable parts.	Dismantle the No. 1 engine.	2	1. Disassemble	
Dispatch	To send off or away with promptness or speed.	Dispatch report to supervising technician.	-		
Display	To exhibit, show, or make prominent.	Display the barrels to the staff officials.	2	1. Show 3. Exhibit	
Dispose of	To get rid of.	Dispose of unused hydraulic fluid left in the pan.	-		
Distribute	1. To apportion for a specific purpose or to particular persons or things.	1. Distribute the various maintenance tasks to technicians.	2	1. Assign 3. Allocate	
	2. To divide among several or many; to divide or separate, especially into kinds.	2. Distribute paint for various sections of the aircraft.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Divide	To cause to be separate, to sever into two or more parts or pieces.	Divide the work evenly between the two engineers.	2	1. Slit 3. Separate	
Douse	To plunge suddenly into water; to immerse.	Douse the film in the acetone to see if it becomes flexible.	3	1. Dip 2. Submerge	
Drain	To draw off (liquid) gradually or completely.	Drain servicing hose after removing it from the filter valve.	-		(For opposite, see Fill)
Draw in	To pull (liquid) up into a container through suction.	Fill hydrometer by drawing in electrolyte.	-		
Dry	To cause to be free from water or liquid.	Dry bearings with low pressure air.	-		
Dry out	To cause to be entirely evaporated; to render or become entirely dry.	Dry out the entire chamber before testing your item.	1	2. Bake 3. Scorch 4. Parch	
Duck-in	To turn in a raw edge of a metal sheet slightly. This is done usually to facilitate assembling two parts of a container.	Duck-in the metal to prevent injury.	2	1. Clasp	
Effect	To do, carry out or bring about; to reach an objective.	Effect a periodic inspection on the landing gear.	3	1. Perform 2. Accomplish	
Eliminate	To expel; to ignore or set aside as unimportant.	Eliminate all unnecessary movement.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Emboss	To create a design on a surface by causing the letters, figures, patterns, etc; to be raised by pressure, rollers, etc.	Emboss the print on the package to give it a more realistic image.	4	1. Engrave 2. Imprint 3. Etch	
Employ	To put into action or service, to carry out a purpose or action by means of; to avail oneself of.	Employ only antimagnetic fasteners.	3	1. Use 2. Utilize	
Enforce	To compel or constrain.	Enforce safety regulations.	-		
Engage	To cause to interlock or mesh.	Engage threads of turnbuckle with threads of cable terminal.	-		For circuit breakers, use "close."
Engrave	To impress cut or etch a configuration into a plate.	Engrave his initials on the roller.	1	2. Imprint 3. Etch 4. Emboss	
Enter	1. To go or come in.	1. Enter the aircraft through troop doors.	-		
	2. To put on record.	2. Enter the data on the form.	-		
Erect	To put up by the fitting together.	Erect a special maintenance stand.	-		
Establish	To set on a firm basis.	Establish safety rules.	-		
Estimate	To judge or determine roughly the size, extent or nature of.	Estimate amount of cleaning solvent which will be necessary.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Etch	1. To corrode the interior of a tin can sufficiently to be visible instead of a polished surface.	1. Etch the inside of the container as a pre-coating process.	2	1. Scrape	
	2. To treat a material with an acid leaving the parts of material which remain in relief to form the desired design.	2. Etch the outline of the design on the film.	3	1. Engrave 2. Imprint 4. Emboss	
Evaluate	To determine the importance, size or nature of; to appraise; to give a value or appraisal to on the basis of collected data.	Evaluate an operating engine.	1	2. Assess	
Examine	To perform a critical visual observation or check for specific conditions; to test the condition of.	Examine the component for wear, deterioration or defects.	2	1. Inspect 3. Check	
Exhibit	To present to view, to show, to display anything for inspection.	Exhibit the items to the management.	3	1. Show 2. Display	
Expand	To enlarge, to make occupy more space, to spread apart.	Expand the film by heating it very slightly.	4	1. Grow 2. Swell 3. Bloom	
Expedite	To accelerate the process or progress of.	Expedite the activity by assigning two men.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Express	To send goods by express.	Express those four items and send the others by air.	2	1. Ship	
Extend	To cause to be drawn out to fullest length.	Extend the main landing gear.	-		
Extract	To draw forth; to pull out forcibly.	Extract the cotter pin.	-		
Fabricate	To construct from standardized parts.	Fabricate rig pins from 0.25 inch rod.	3	1. Make 2. Construct	
Fasten	To make firm, to cause to hold together, to affix.	Fasten the film to the inside of the corrugated box.	3	1. Seal 2. Staple 4. Stationary 5. Immobilize	
Figure	To determine by arithmetic processes.	Figure the voltage in a circuit with 10 amps of current and 5 ohms of resistance.	2	1. Calculate 3. Compute	
File	To rub smooth or cut away with a file (i.e., a tool with cutting ridges for forming or smoothing surfaces).	File one end of the rod to a point.	-		
Fill	To put into as much as can be held or conveniently contained or to a specified level.	Fill oil and deicing tanks.	-		(For opposite, see Activate)

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Find	1. To discover or determine by search; to indicate the place, site or limits of.	1. Find the No. 9 fitting.	2	1. Locate	
	2. To discover by study or experiment; to investigate and decide.	2. Find the amount of tension on a cable by following specified procedures.	2	1. Determine	
Flag	To point out or place a marker.	Flag the area we are to work in.	2	1. Point out 3. Signal	
Flange	To hold in place or give strength.	Flange the rim so as not to fall on the neck.	4	1. Spread out 2. Extend 3. Protrude	
Flush	To pour liquid over or through; to wash out with a rush of liquid.	Drain and flush the hydraulic system if it is serviced with a wrong fluid.	-		
Fold	To bend, lap, or lay one part over another part or to double upon itself.	Fold the flaps together to form the bottom of the box.	1	2. Lap 3. Wrap 4. Hem 5. Crease	
Follow	To accept as authority; to obey; to conform with directions or rules.	Follow directions.	1	2. Comply with	
Form	To give a particular shape to; to shape or mold into a certain state; to make up.	Form the compound so that it will fill the hole completely.	-		
Form-roll	To pass a metal sheet through steel rollers to form a body cylinder of a drum.	Form-roll the heavy material so as to obtain sturdier drums.	2	1. Press	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Fortify	To become, grow, or make strong; to strengthen.	Fortify all the sides of the container with corrugated board.	4	1. Support 2. Brace 3. Strengthen	
Furnish	To supply what is needed, to equip.	Furnish a flashlight for man B.	2	1. Provide	
Fuse	To join two surfaces by heating them just beyond their melting point.	Fuse the sides of the metal container together.	2	1. Join 3. Unite 4. Weld	
Galvanize	To coat iron and steel with zinc either by electroplating or hot dipping.	Galvanize all the steel for this project.	3	1. Coat 2. Plate	
Glass	To pack or can in glass.	Glass pack all necessary items.	1	2. Glaze	
Glaze	To incrust, cover, or overlay with a thin surface consisting of, or resembling, glass; to furnish or fit with glass.	Glaze the surface with the appropriate film.	2	1. Glass 3. Laminate	
Glue	To cause to adhere or to apply adhesives.	Glue the flaps down to the package.	1	2. Attach 3. Adhere 4. Stencil	
Go to	To proceed to; to transport oneself to a given destination.	Go to the control pedestal and position switches appropriately.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Ground	To connect a current, wire or piece of electrical equipment to a land or other specified surface.	Ground the servicing cart.	-		
Grow	To increase in bulk; to develop, enlarge.	Grow the foam to an ILD of 30 lbs. per 100 square inches.	1	2. Swell 3. Expand	
Guard	To protect from danger, to defend.	Guard the area while maintenance is taking place.	-		
Guide	To manage or direct the movement of.	Guide the maintenance stand safely to its new position.	-		
Hand	To give, pass or transmit with the hands.	Hand the refueling hose to the technician stationed on the wing.	-		
Handle	To manipulate (load, turn, raise, etc.) objects and equipment manually or with specially designated equipment, such as hoists.	Handle charger cylinders carefully.	-		
Hang	To fasten to some elevated point without support from below, to suspend.	Do not hand tools on projecting parts of the aircraft.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Help	To give support, aid or assistance to.	Help man B lift the load.	2	1. Assist 3. Aid	
Hem	To turn over and flatten down an edge of a sheet.	Hem all the sheets so there is no bulging.	3	1. Fold 2. Lap 4. Seam	
Hinge	To connect two parts in such a way that they move at angles from each other	Hinge the sides of the top of the crate so it will be easier to open.	4	1. Join 2. Connect 3. Attach	
Hold	To have or keep in the grasp.	Hold the power switch in position until the voltmeter stabilizes.	–		
Humidify	To moisten or dampen.	Humidify the room so we can run moisture tests.	4	1. Wet 2. Dampen 3. Moisten	
Identify	1. To establish the identity of.	1. Identify components by name and function.	–		
	2. To determine the classification of a supply item.	2. Identify the component to be ordered from supply.	–		
Idle	To run an aircraft engine under reduced power without sufficient power being developed for movement of the aircraft.	Idle the engine for five minutes at 800 rpm.	–		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Immerse	To plunge into something that surrounds or covers, especially to plunge or dip into a fluid.	Immerse component in solvent.	-		
Immobilize	To secure a package or items within a container or transport unit.	Immobilize the products to insure their safety.	3	1. Fasten 2. Stationary	
Imprint	To impress or mark by pressure; to stamp or mark by means of type.	Imprint the design so we can use it for our insignia.	3	1. Print 2. Engrave 4. Etch 5. Emboss	
Improve	To make greater in amount or degree; to make better.	Improve procedures whenever feasible.	-		
Indicate	To point out.	Indicate which dial should be monitored.	-		
Inflate	To fill with a given amount of gas or air.	Inflate tire to desired pressure.	-		
Inform	To make known to; to give notice or report the occurrence of.	Inform man B that the brakes have been set.	2	1. Report to 3. Notify 4. Advise 5. Communicate to	
Initiate	To perform actions necessary to set into operation, to set going, to begin.	Initiate operation of the powered AGE.	2	1. Start 3. Originate	
Inject	To throw, drive or force in.	Inject lubricant into proper joint.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Insert	To put or thrust in, into or through.	Insert a wire through the hole in the turnbuckle.	1	2. Put 3. Plug 4. Interleave	
Inspect	To perform a critical visual observation or check for specific conditions; to test the condition of.	Inspect the components for wear, deterioration or defects.	1	2. Examine 3. Check	
Install	1. To perform operations necessary to properly fit an equipment unit into the next larger assembly or system.	1. Install fuel manifold.	-		a. For wiring a circuit, use either "install wiring" or "wire."
	2. To place and attach.	2. Install nuts or bolts.			b. For safety wiring use either "safety wire" or "install safety wire." c. For screws, use "install screws" rather than "screw." d. Use "cap" "plug" rather than install caps (plugs).

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Insure	To make certain, to ensure.	Insure that the area is clear of unnecessary personnel and equipment.	-		
Intercept	To stop or interrupt the progress or course of.	Intercept messages between flight station and tail section technicians.	-		
Interleave	To insert separating sheets of paper etc between foil or other stacked sheet material to facilitate handling or to prevent blocking or smudging.	Interleave gaps between the papers so that handling will be easier.	2	1. Insert	
Interpret	To explain the meaning of.	Interpret instructions for inexperienced technicians.	-		
Investigate	To observe or study by close examination and systematic inquiry.	Investigate the cause of the breakdown.	-		
Isolate	To use test equipment to identify or select a source of trouble.	Isolate the source of the malfunction using pressure gages.	-		
Jack	To use one or more jacks (i.e., mechanisms for exerting pressure to lift all or part of an aircraft).	Jack and level the aircraft in accordance with specified procedures.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Join	To bring or fit together so as to form a unit; to couple keyed or matched equipment items.	Join the transmitter to the receiver with the power cable.	8	1. Bond 2. Fuse 3. Unite 4. Weld 5. Connect 6. Attach 7. Mate 9. Splice 10. Hinge 11. Sweat	
Keep	To remain, to continue in a place.	Keep away from the danger area.	2	1. Stay	
Kick	To strike against with a foot.	Kick the wheel lightly if the strut binds.	-		
Knock	To drive or be driven against something; to collide or clash.	Knock the pins from the testing equipment so the film may be inserted.	2	1. Bump 3. Strike	
Knurl	To serrate a surface.	Knurl the edge of the foam to give more protection to the product.	4	1. Cut 2. Notch 3. Serrate	
Label	To attach a label either manually or by a labeling machine.	Label all testing equipment to their capacity load.	3	1. Mark 2. Tag	
Lace	To attach laces to inside edges of a base or to fray of a set up paper box manually operated or by a lacing machine.	Lace the edges of the fiberboard together.	1	2. Braid 3. Weave	
Laminate	To unite layers of materials by extrusion or with adhesives.	Laminate the films with glue so they will hold together.	3	1. Coat 2. Glaze	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Lap	To extend beyond; to form a lap.	Lap the sheet metal together to form a secured joint.	2	1. Fold 3. Wrap 4. Hem 5. Seam	
Latch	To catch with a device which holds a door when closed, even if not bolted.	Close and latch the aft petal doors.	-		
Layer	To stack commodities in layer or single thickness folds.	Layer the foam lengthwise against the wall.	3	1. Stack 2. File	
Leave	1. To go away from, depart.	1. Do not leave the area until this activity is complete.	-		
	2. To allot or provide for.	2. Leave a two-inch slack in the rope.	2	1. Allow	
Let	To permit; to give opportunity to.	Let the engine stabilize.	2	1. Allow	
Level	To cause an aircraft to become even or parallel with the plane of the horizon.	Jack and level the aircraft in accordance with specified procedure.	-		
Lift	To move or cause to be moved from a lower to a higher position; to elevate.	Lift the spoiler control lever to the ARMED position.	2	1. Raise	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Light	To cause to illuminate.	Light the field indicator light.			
Line	To apply a lining or coating to a material or container by painting, pasting, spraying, etc.	Line the barrel with moisture resistant solvent.	3	1. Coat 2. Cover	
Listen	To pay attention to sound.	Listen to the engine while it is operating.	-		
Load	To place in or on a means of conveyance; to place cargo or aircraft components on an airplane or other vehicle.	Load and secure aircraft components on specified truck.	-		
Locate	1. To find, determine or indicate the place, site or limits of.	1. Locate the No. 9 fitting.	4	1. Position 2. Place 3. Set 5. Put 6. Register	
	2. To set or establish in a particular spot; to station.	2. Locate the test equipment so that it can be seen by both technicians.	3-4	1. Position 2. Place 3-4. Set 5. Put	
Lock	To hold fast or inactive; to fix.	Lock the throttle after it has been properly set.	-		
Look for	To visually search for.	Look for cracks, corrosion and damage during inspection of wheels and tires.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Loop	To make into the form or shape of a loop (i.e., a fold or doubling of line leaving an aperture between the parts through which another line can be passed).	Loop the wire.	-		
Loosen	To release from restraint; to cause to become less tight fitting.	Loosen the lock nut on the relief valve.	-		(For opposite, see Secure)
Lower	To cause to move down; to depress as to direction.	Lower the exhaust stack into the stowed position.	-		
Lubricate	To put lubricant on specified locations.	Lubricate the wheel bearings.	1	2. Apply lubricant	
Maintain	1. To hold or keep in any particular state or condition, especially in a state of efficiency or validity.	1. An aircraft mechanic maintains aircraft.	-		
	2. To sustain or keep up.	2. Maintain standard forms on power plant operations.	-		
Make	To carry out or cause to occur.	Make corrections where necessary.	-		
Make ready	To be prepared to act or be used immediately.	Make ready the specimen for testing.	4	1. Prepare 2. Alert 3. Ready 5. Preset	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Mark	To label; to provide with an identifying or indicating symbol.	Mark each component before removing it.	-		If marking is to be done on a tag, use "tag."
Mate	To join or fit together; to couple.	Mate the proper transmitter and receiver.	3	1. Connect 2. Attach 4. Join	
Measure	To determine the dimensions, capacity or amount by use of standard instruments or utensils.	Measure voltage drop across each unit of resistance.	-		
Mix	To combine or blend into one mass.	Never mix oxygen with other gases.	-		
Modify	To alter or change somewhat the form or qualities of.	A jet engine mechanic modifies turbofan engines.	-		
Mold	To shape in, or as in, a mold; or by folding, kneading, etc.	Mold the film to conform to the dimensions of the box.	2	1. Form 3. Cast 4. Preform 5. Die-cut	
Moisten	To wet slightly; to make moist or wet.	Moisten the outside of the container to prevent scorching.	3	1. Wet 2. Dampen 4. Humidity	
Monitor	1. To visually take note of; to pay attention to in order to check on action or change.	1. Monitor the indicator for changes in air speed.	3	1. Observe 2. Watch	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Monitor (Cont'd)	2. To continually or periodically attend to displays to determine equipment condition or operating status.	2. Monitor all engine instruments while starting the engines.	-		
Moor	To secure an aircraft to the ground by tying it down by ropes or cables.	Moor the aircraft when it is to be parked for an extended period of time.	-		
Mount	To attach to a support.	Mount the split-type wheel.	-		
Move	To change the location or position of.	Move and position a B-4 maintenance stand.	2	1. Ship 3. Transport 4. Express	
Neck-in	To form a portion of a container to a smaller size than the main part.	Neck-in the can so the foam will fit in properly.	3	1. Reduce 2. Modify	
Neglect	To treat with little or no attention; to pass unheeded.	Neglect the value determined from the faulty chamber.	4	1. Skip 2. Pass over 3. Omit	
Neutralize	To destroy the effectiveness of; to nullify; to make chemically neutral or electrically inert.	Neutralize the solution before applying it to aircraft surface.	-		
Notch	To cut away small portions of an area of packaging material, usually at the corners to provide for lock seaming.	Notch the foam so it will fit tightly into the container.	2	1. Cut 3. Score 4. Serrate 5. Knurl	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Notify	To make known to; to give notice or report the occurrence of.	Notify man B that the brakes have been set.	3	1. Report to 2. Inform 4. Advise 5. Communicate to	
Observe	1. To conform one's actions or practice to.	1. Observe precautions.	-		
	2. To visually take note of; to pay attention to.	2. Observe the indicator for changes in airspeed.	1	2. Watch 3. Monitor	
Obtain	1. To get or find out by observation or special procedures.	1. Obtain a reading on the outside circle of the tensiometer.	2	1. Take	
	2. To gain or attain.	2. Obtain the necessary supplies before starting on maintenance.	-		
Omit	To leave out, exclude.	Omit all of the tests on the wooden pallets.	3	1. Skip 2. Pass over 4. Neglect	
Open	1. To move from closed position; to make available for passage by turning in an appropriate direction.	1. Open the valve.	-		
	2. To make available for entry or passage by turning back, removing or clearing away.	2. Open the troop door.	-		
	3. To disengage or pull.	3. Open the appropriate circuit breakers.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Operate	To control equipment in order to accomplish a specific purpose.	Operate crew stands and auxiliary power equipment.	-		
Order	1. To requisition or request from supply.	1. Order three cans of appropriate solvent.	-		
	2. To group according to quality, value, or other characteristics.	2. Order components by size from smallest to largest.	2	1. Arrange	
Organize	To arrange elements into a whole of interdependent parts; to form into a coherent unity; to integrate.	Organize the activities of the assisting technicians.	-		
Orient	1. To acquaint with the existing situation or environment.	1. Orient new technicians to location of shops and supplies.	-		
	2. To set or arrange in any determinate position.	2. Orient the aircraft away from wind direction.	-		
Originate	To give rise to; to set going; to begin.	Originate a new procedure.	3	1. Start 2. Initiate	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Overhaul	The act of disassembling equipment units down to all removable parts; cleaning; critically inspecting, repairing, restoring and replacing where necessary; assembling, adjusting, aligning, recalibrating and verifying operational readiness by test or checkout; and packaging for transportation storage.	Overhaul the No. 2 engine.	-		
Overwrap	To apply an overwrap.	Overwrap all necessary items.	2	1. Wrap	
Pack	To fill completely with grease.	Pack the bearings.	-		
Paint	To apply color or pigment (suspended in suitable liquid) to the surface of.	Paint all exposed surfaces.	-		
Panel	1. To distort a round package by forcing in the sides to produce one or more flat surfaces.	1. Panel the circular package so it will fit tighter into position.	3	1. Change 2. Adjust	
	2. To raise or depress part of a flat surface to improve the appearance, stiffen the surface or alter the capacity.				

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Parch	To burn the surface of; to dry to extremity; to shrivel with heat.	Parch the surface of the corrugated board so the final test can be run.	4	1. Dry out 2. Bake	
Park	To bring (an aircraft) to a stop and leave it standing for a time, usually without pilot, in a specified area.	Park the aircraft between the yellow lines.	-		
Pass over	To pass without stopping touching, or noticing; to overlook.	Pass over the drop test, it is not necessary to proceed.	2	1. Skip 3. Omit 4. Neglect	
Patch	To mend, cover, or fill up a hole or weak spot.	Patch the tubes where necessary.	-		
Perform	To do, carry out or bring about; to reach an objective.	Perform a periodic inspection on the landing gear.	1	2. Accomplish 3. Effect	
Pile	To lay or put in a pile; to stack, to accumulate.	Pile all the foam to be tested in the corner.	2	1. Stack 3. Collect 4. Layer	
Place	To put or set in a desired location or position.	Place the test equipment so that it can be seen by both technicians.	2	1. Position 3. Set 4. Locate 5. Put 6. Register	
Plan	To devise or project the achievement of.	Plan the day's schedule for the technicians.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Plate	To cover or coat with metal, as to plate steel sheet with zinc, tin, etc.	Plate the metal so it can be used as a conductor of electricity.	3	1. Cover 2. Coat 4. Galvanize	
Plug	To provide with a device for closing off the end of a tube which has a female fitting.	Plug all lines which have exposed female fittings.	1	2. Insert plugs 3. Install plugs	
Plug in	To attach or mate (an electrical device) to a service outlet.	Plug in the soldering iron at the service power outlet.	1	2. Connect	
Point out	To indicate the position direction of.	Point out all of the vital points of the drop test.	1	2. Flag	
Position	To put or set in given place, to locate.	Position the test equipment so that it can be seen by both technicians.	1	2. Place 3. Set 4. Locate 5. Put 6. Register	
Post	To station at a given place.	Post one man in front of the aircraft.	-		
Preform	To make plastic molding powder into pellets or tablets.	Preform all of the powder so the pellets will be ready when we need them.	4	1. Form 2. Mold 3. Cast 5. Die-cut	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Prepare	To make ready; to arrange things in readiness.	Prepare the surface for paint	-		
	To prepare or make ready for a maintenance activity.	Prepare the Trunion Shaft Kit for removal of the MLG shock strut.	1	2. Set up 3. Ready	
Prescribe	To lay down as a guide, direction or rule of action; to specify with authority.	Prescribe repair activities to correct the malfunctions.	-		
Preset	To put in a desired position, adjustment or condition beforehand.	Preset tension indicator dial to size of cable being checked.	-		
Press	To act upon through thrusting force exerted in contact.	Press the blower start button.	1	2. Push 3. Form-Roll	For circuit breakers, use "close."
Pressurize	To apply pressure within by filling with gas or liquid.	Pressurize the booster hydraulic system.	-		
Prevent	To keep from happening or existing.	Prevent oil from spilling over on components.	-		
Print	To transfer written matter or design to an object, usually by means of a stamp, die, or printing press, with ink as the medium.	Print the information accurately and precisely.	2	1. Copy 3. Imprint 4. Transfer	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Probe	To investigate thoroughly with a long, pointed device or by direct feeling.	Probe the tube with fingers.	–		
Process	To submit to a series of actions or operations leading to a particular end.	Process the forms so they will be compatible with new recording methods.	–		
Program	To work out a plan or procedure or a sequence of operations to be performed.	Program the maintenance activity in logical sequence.	–		
Proof	To apply special protective qualities.	Proof the material with a laminating substance.	3	1. Coat 2. Cover 4. Underprint	
Protrude	To extend beyond; to project or stick out.	Protrude all of the corners so the board will be more stable.	3	1. Spread out 2. Extend 4. Flange	
Provide	To supply what is needed, to equip.	Provide a flashlight for man B.	1	2. Furnish	
Pull	To exert force upon an object so as to cause motion toward the force.	Pull out knob No. 6 on the oxygen servicing cart.	–		For circuit breakers, use "open."

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Pump	1. Raise or lower by operating a device which raises, transfers or compresses fluids by suction, pressure or both.	1. Pump up the ramp several inches.	-		
	2. To move up and down or in and out as if with a pump handle.	2. Pump engine primer knob.	-		
Puncture	To pierce with pointed instrument or object.	Be careful not to puncture tube while probing the inside of it.	-		
Purge	1. To free of sediment or trapped air by flushing or bleeding.	1. Purge fuel tanks.	-		
	2. To remove fuel or fuel vapors from engine by motoring engine with fuel switch off.	2. Purge engines.	-		
Push	1. To press against with force so as to cause motion away from the force.	1. Push the blower start button.	2	1. Press	For circuit breakers, use "close."
	2. To move away or ahead by steady pressure.	2. Push the servicing cart toward the aircraft.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Put	1. To place in or through.	1. Put a wire through the hole in the turnbuckle.	2	1. Insert	
	2. To place or set in a desired position or location	Put the test equipment where it can be seen by both technicians.	5	1. Position 2. Place 3. Set 4. Locate 6. Put away 7. Store	Use "store" instead of "put away" for depositing or leaving in a specified place for future use.
	3. To deposit or leave.	3. Put tools out on the bench.	-		
	4. To lay or spread on or in.	4. Put sealant in the gap between the windshield and the aircraft structure.	2	1. Apply	
Qualify	To declare competent or adequate.	Qualify components which check out successfully.	-		
Raise	To move or cause to be moved from a lower to a higher position, to elevate.	Raise the spoiler control lever to the ARMED position.	1	2. Lift	
Read	To interpret the meaning of by visual observation.	Read the ammeter.	-		
Readjust	To adjust again, to move back to a specified condition; to bring back to an in-tolerance condition.	Readjust the voltage after performing an operational check of the system.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Ready	To prepare for a maintenance activity.	Ready the Trunion Shaft Kit for removal of the MLG shock strut.	3	1. Set up 2. Prepare 4. Make-ready 5. Alert 5. Preset	
Reassemble	To refit and secure together the parts of after they have been taken apart.	Reassemble component before installation on aircraft.	-		
Recall	To call back.	Recall parts which have not been modified.	-		
Recap	To cap again; to replace a covering; to reinstall a fitting for closing the end of a tube.	Recap the filler valve.	-		
Recapitulate	To repeat briefly.	Recapitulate the task sequence.	-		Use "repeat briefly."
Receive	To come into possession of; to get.	Receive supplies as they arrive.	-		
Recognize	To perceive to be something previously known or designated.	A jet engine mechanic recognizes troubles through evaluation of engine operational checks.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Recommend	To urge the acceptance or use of.	Recommend procedure changes where appropriate.	-		
Recondition	To renew; to bring or put back into good condition.	Recondition the pilot's and copilot's seats.	1	2. Renovate	
Reconnect	To rejoin or refasten that which has been separated.	Reconnect aft pistons to forward pistons.	-		
Record	To set down in writing.	Record maintenance time on appropriate form.	-		
Reduce	To cause to be diminished in strength, density or value.	Reduce pump flow.	-		
Refuel	To put fuel into the tanks of (an aircraft) again.	Refuel the system as outlined from applicable technical manuals.	-		
Register	To have one part positioned accurately with respect to another.	Register all the impressions accurately.	3	1. Place 2. Position 4. Locate	
Regulate	To fix or adjust the time, amount or rate of; to exercise restraining or directing influence over.	Regulate electrical current generation and distribution.	1	2. Control	
Reinflate	To refill with a given amount of gas or air after deflation has occurred.	Reinflate tires to specified psi value.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Reject	To refuse to have, use or take for some purpose.	Reject components which show excessive wear.	-		
Relay	To pass along by stages.	Relay the message to man D.	-		
Release	1. To set free from an inactive or fixed position; to unfasten or detach interlocking parts.	1. Release the parking brake.	1	2. Disengage 3. Unlock	
	2. To let go of.	2. Release tensiometer handle.	-		
	3. To set free from restraint or confinement.	3. Release pressure.	-		
Relieve	To ease or set free of a burden, to partially release.	Relieve hydraulic pressure before working on a system.	-		
Remove	1. To perform operations necessary to take an equipment unit out of the next larger assembly or system.	1. a. Remove bleed air shutoff valves. b. Remove bolts from nuts.	-		For screws, use "remove" rather than "unscrew."
	2. To take off or eliminate.	2. Remove paint.	-	Scrape	(For opposite, see Apply)
	3. To take or move away.	3. Remove jacks.	-		
	4. To take off devices for closing off the end of a tube.	4. Remove caps (plugs) from all hydraulic lines.	1	2. Uncap 3. Unplug 4. Unscrew	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Renovate	To renew; to bring or put back into good condition.	Renovate the pilot's and copilot's seats.	2	1. Recondition	
Repair	To restore damaged, wornout or malfunctioning equipment to a serviceable, usable or operable condition.	Repair engine by replacing parts and removing defects.	-		Repair includes replacement, overhaul and reworking of constituent parts or materials.
Repeat	To make, do or perform again.	If keys do not engage lugs, remove wheel assembly and repeat procedure.	-		
Replace	1. To restore to a former place or position.	1. Replace covers on jacks.	-		
	2. To substitute serviceable equipment for malfunctioning, wornout or damaged equipment.	2. Replace the switch contact points.	1	2. Change	
Replenish	To fill or build up again.	Replenish drinking water when supply runs low.	-		
Report	To describe as being in a specified state.	Report when ready.	1	2. Inform 3. Notify 4. Advise 5. Communicate to	
	To make known to; to give notice or report the occurrence of.	Report to man B that the brakes have been set.			

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Repressurize	To reapply pressure within by filling with gas or liquid after pressure has been released.	Repressurize the utility hydraulic system.	-		
Request	To ask for.	Request further information if necessary.	-		
Reset	To put back into a desired position, adjustment or condition.	Reset the field after performing an operational check of the generator.	-		
Resolve	To clear up or find an answer to; to reach a decision about.	Resolve the inconsistency before proceeding with maintenance activity.	-		
Restore	To bring back or put back into a former or original state.	Restore hydraulic pressure.	-		
Retard	To manipulate so as to hold back or slow down, to hold back or slow down.	Retard the throttle.	-		
Retract	To draw up against or into the aircraft.	Retract the landing gear.	-		
Return	To bring, send or put back to a former or proper place.	Return the horizontal stabilizer to the neutral position.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Review	To examine again; to go over or examine critically or deliberately.	Review procedures which have not been performed for more than two months.	-		
Rewind	To wind again; especially the winding of a roll of paper, film or other flexible packaging material after printing, slitting, etc; to transfer to other rolls, usually smaller, after slitting, etc.	Rewind the paper to the beginning of the roll.	3	1. Repeat 2. Reset 4. Restore	
Rework	To reprocess for further use; to revise.	Rework the report forms.	-		
Rig	To assemble, adjust and align the major components of an aircraft (i.e., airfoils or other surfaces); to fit out (an aircraft) with control cables, bracing cables, pulleys, turnbuckles, etc.	Rig and adjust the mechanical linkage in the flight control system.	-		
Rinse	To cleanse (as from soap used in washing) by clear water.	Rinse the battery after cleaning it with soda water solution.	-		
Rope off	To partition, separate or divide by a rope (i.e., a large stout cord of strands of fibers or wire twisted or braided together).	Clear and rope off an area around the aircraft and post warning signs.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Rotate	To cause to revolve about an axis or center.	Rotate the door handle counter clockwise until catches retract.	2	1. Bend 3. Turn	
Route	To send by a selected course of travel; to divert in a specified direction.	Route the memo to all affected personnel.	-		
Rub	To move along the surface of a body with pressure.	Rub hands around connections.	-		
Safeguard	To provide a technical contrivance to prevent accident; to comply with precautionary measures or stipulation.	Safeguard technical manuals.	-		
Safety	1. To secure an aircraft part against loosening from vibration.	1. Safety the lock nut on the relief valve.	-		
	2. To use safety wire to make an aircraft component fast or safe or secure against loosening from vibration.	2. Safety the bolts with wire.	3	1. Safety wire 2. Secure (with wire) 4. Install (with wire)	
	3. To use a cotter pin to make an aircraft component fast or safe or secure against loosening from vibration.	3. Safety the bolt with a cotter pin.	3	1. Secure 2. Install	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Safety wire	To use safety wire to make aircraft component fast or safe or secure against loosening from vibration.	Safety wire the bolts.	1	2. Secure (with wire) 3. Safety 4. Install (with wire)	
Salvage	To rescue or save (as from discard, wreckage or ruin).	Salvage fuel which is drained from tanks.	-		
Scan	To make a wide, sweeping search of; to look through or over hastily.	Scan the flight engineer's panels before beginning maintenance activity.	-		
Schedule	To appoint, assign or designate for a fixed future time; to make a timetable of.	Schedule maintenance activities for the day.	-		
Scorch	To burn superficially; to shrivel with heat.	Scorch the surface of the corrugated board so the final test can be run.	3	1. Dry out 2. Bake 4. Parch	
Score	To make an impression or partial cut in a flat material for the purpose of facilitating bonding, creasing, folding, or tearing.	Score the corrugated board so it will fit in the carton.	3	1. Cut 2. Notch 4. Serrate	
Scrap	To retire from use.	Scrap the excess material.	1	2. Dispose of 3. Eliminate	
Scrape	To scratch; to draw harshly or roughly over.	Scrape the outside of the barrel so it is free of rust.	2	1. Rub 3. Scuff 4. Etch	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Screw	1. To attach, fasten or close by means of a screw.	1. Screw the ram safety lock to the ram.	-		
	2. To attach by means of a twisting motion in the proper direction.	2. Screw in jack pad.	-		
	3. To attach screws by means of a twisting motion in the proper direction.	3. Screw in twelve screws around cover.	2	1. Install	
Scrub	To clean with hard rubbing.	Scrub all metal parts with a white powder deposit on them.	-		
Scuff	To rub or abrade.	Scuff the surface lightly with a piece of sandpaper.	3	1. Rub 2. Scrape	
Seal	To secure or fasten,	Seal the lid tightly to the top of the box.	2	1. Close 3. Fasten 4. Secure	
Seam	To form a seam by butting, overlapping, sewing, or otherwise fastening together two edges of any material.	Seam seal the bag closed with intense heat and adhesives.	3	1. Lap 2. Hem 4. Crease	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Secure	1. To make fast or safe.	1. Load and secure components on trucks.	-	Immobilize	(For opposi see Loosen)
	2. To safety (with safety wire or cotter pin) to make aircraft component fast or safe or to keep it from loosening during vibration.	2. a. Secure bolts with safety wire.	2	1. Safety wire 3. Safety 4. Install (with wire)	
		b. Secure the bolt with a cotter pin.	1	2. Install 3. Safety	
Select	To take by preference or fitness from a number or group, to pick out, to choose.	Select a battery cell and insert hydrometer nozzle in the cell.	-		
Separate	To set apart from others; to sever.	Separate the various types of film according to speed.	3	1. Slit 2. Divide	
Serrate	To notch or make serrations.	Serrate the edges of the foam so it is uniform with the other side.	4	1. Cut 2. Notch 3. Score 5. Knurl	
Service	To perform such operations as cleanup, lubrication and replenishment to prepare for use.	Service each battery cell to only 3/8 inch above the plates.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Set	1. To put a switch, pointer or knob into a given position; to put equipment into a given adjustment, condition a mode.	1. Set PWR switch to ON.	-		
	2. To put or place in a desired orientation or location.	2. Set the test equipment so that it can be seen by both technicians.	3	1. Position 2. Place 4. Locate 5. Put	
Set up	To prepare or make ready for a maintenance activity.	Set up the Trunion Shaft Kit for removal of the MLG shock strut.	2	1. Prepare 3. Ready	
Shake	To move or cause to move to and fro in a quick, jerky manner.	Shake the container so that the paint will be well mixed.	-		
Shear	To cut, clip, or sever something.	Shear the corners of the foam so it will fit properly into the box.	3	1. Cut 2. Clip	
Ship	To send, to move from one place or position to another.	Ship the cushioned cartons to the proper address.	1	2. Move 3. Transport 4. Express	
Show	To present or place in sight; to permit to be seen.	Show the results of the test on a flip chart.	1	2. Display 3. Exhibit	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Shut down	To perform operations necessary to cause an equipment to cease or suspend operation.	Shut down the air conditioning.	1	2. Stop	
Signal	To notify or communicate by signals (i.e., a prearranged sign, notice or symbol conveying a command, warning, direction or other message).	Signal the pilot to move the aircraft to the left.	-		
Simulate	To give the appearance or effect of.	Simulate doppler radar signals.	-		
Single seam	To attach an end to an unflanged can body by a method which four thicknesses of plate are interlocked or folded and pressed firmly together, the hook on the body being eliminated.	Single seam the end flap to the carton.	-		
Size	To bring apart to the dimensions required.	Size the film to the appropriate dimensions.	1	2. Measure 3. Dimension	
Skip	To miss or jump over a spot.	Skip the tensile strength test.	1	2. Pass over 3. Omit 4. Neglect	
Slide	To cause to move in a smooth manner over a surface.	Slide the stand in close enough to do the work.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Slit	To cut roll stock to specified widths; either rotary or stationary knives or blades are used with mechanical unwinding and rewinding devices.	Slit the foam perpendicular to the edge of the box.	2	1. Cut 3. Divide 4. Separate	
Slush	To wash or coat the interior surfaces of a container by partially filling with a liquid, followed by agitating the contents.	Slush the barrel with the solvent.	3	1. Wash 2. Coat	
Sort	To put in a certain place or rank according to kind, class, etc; to select or separate.	Sort the rubber goods according to their cure date.	1	2. Select 3. Cull	
Specify	To name or state explicitly or in detail.	Specify the manufacturer's number of the multimeter.	-		
Spill	To cause or allow to fall, flow or run out.	Be careful not to spill battery acid on clothing, hands.	-		
Spin	To cause to revolve rapidly.	Spin wheel by hand until a bearing drag is noticed.	-		
Splice	To unite or join the ends of ropes or wire cables.	Splice the two wires together.	3	1. Join 2. Connect	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Spray	To apply with a device which disperses a jet of finely divided liquid.	Spray the fuselage and tail sections moving from center to ends.	-		
Spread out	To extend in length or breadth.	Spread out the center of the pipe with a center punch.	1	2. Extend 3. Protrude 4. Flange	
Stack	To pile articles in vertical rows.	Stack the styrofoam in the corner.	1	2. Pile 3. Collect 4. Layer	
Staple	To apply a staple or to fasten by means of staples.	Staple the corrugated box together.	1	2. Fasten 3. Hold 4. Stitch	
Start	To perform actions necessary to set into operation, to set going, to begin.	Start the powered AGE.	1	2. Initiate 3. Originate	
Stationary	One who or that which is stationary or tends to remain in one place, condition, etc.	Stationary the wall with a brace.	3	1. Staple 2. Fasten 4. Immobilize	
Stay	To remain, to continue in a place.	Stay away from the danger area.	1	2. Keep	
Stencil	To letter or mark a design by means of ink or paint applied through a cutout stencil board.	Stencil the design to the canvas.	2	1. Mark 3. Paint	
Stick	To attach by or as if by causing to adhere to a surface.		1	2. Glue 3. Attach 4. Adhere	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Stimulate	To excite to activity or greater activity.	Stimulate flow by warming the lines.	-		
Stitch	To sew together; to unite by means of thread or staples.	Stitch the flaps to the side of the corrugated board.	2	1. Staple 3. Connect 4. Sew	
Stop	To perform actions necessary to cause an equipment to cease or suspend operation.	Stop the air conditioning.	2	1. Shut down	
Store	To deposit or leave in a specified place for future use.	Store the wheel covers after maintenance activity is completed.	1	2. Stow 3. Put away	
Stow	To deposit or leave in a specified place for future use.	Stow the wheel covers after maintenance activity is completed.	2	1. Store 3. Put away	
Strengthen	To make stronger, add intensity to.	Strengthen the bonds by applying adhesives.	3	1. Staple 2. Brace 4. Fortify	
Strike	To deliver or aim a blow or thrust; to hit.	Strike the designated spot with a hammer.	-		
Submerge	To put under water; to plunge.	Submerge the barrel under water for the final test.	3	1. Dip 2. Immerse 4. Douse	
Submit	To make available; to offer.	Submit request for modification of procedures.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Suggest	To propose as desirable or fitting; to offer for	Suggest any changes which might be helpful.	-		
Superintend	To oversee; to have or exercise the charge of.	Superintend the repair of the engines.	2	1. Supervise	
Supervise	To oversee; to have or exercise the charge of.	Supervise the repair of the engines.	1	2. Superintend	
Support	To hold up or provide a foundation or props for.	Support the elevator at both ends.	-		
Survey	To examine comprehensively as to condition, situation or value.	Survey entire aircraft surface.	-		
Sweat	To bond together by the application of heat surfaces to which solder has already been applied.	Sweat the two units together to make a good connection.	2	1. Join	
Swell	To bulge out by internal pressure.	The water pressure caused excess swelling of the film.	2	1. Grow 3. Bloom 4. Expand	
Synchronize	To cause to happen at the same time.	Synchronize the activities of man A and man B.	-		
Tabulate	To set up in the form of a table (with rows and columns); to compute by means of a table.	Tabulate maintenance times for each occurrence of the various maintenance activities	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Tag	To provide with an identifying or indicating symbol with or as if with a tag (i.e., a cardboard, plastic or metal marker used for identification or classification); to label.	Tag each hydraulic line before removing it.	1	2. Attach a tag 3. Mark 4. Connect a tag to 5. Label	
Take	1. To get into or carry in one's hands or one's possession.	1. Take supplies out to the aircraft.	-		
	2. To get or find out by observation or special procedures.	2. Take a reading on the outside circle of the tensiometer.	1	2. Obtain	
Tap	To strike lightly.	Tap the eye of the cotter pin to seat it.	-		
Temper	To bring to a proper degree of toughness or hardness.	Temper the metal until it reaches 360 degrees.	3	1. Improve 2. Adjust	
Test	To perform specified operations to verify operational readiness of a component, subcomponent, system or subsystem.	Test the true airspeed indicator.	2	1. Checkout	
Throw	To move (a switch) so as to make or break a connection.	Throw switch to ON position.	-		Use "set" for all switches.

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Tie	To fasten, attach or close by means of a line or cord.	Tie mooring ropes to tie points under wing and on nose.	-		
Tighten	1. To perform necessary operations to fix more firmly in place.	1. Tighten all screws.	-		
	2. To apply a specified amount of force to produce a rotation or twisting motion to fix more firmly in place.	2. Tighten the nut to a torque value of 1000 inch-pounds.	2	1. Torque	
Tilt	To cause to slope, lean or incline.	Tilt maintenance stand backwards until wheels contact the ground.	-		
Tip	To seal a small opening in a can with a drop of molten solder.	Tip the hole to prevent any moisture from entering.	2	1. Cap 3. Cover	
Torque	To apply a specified amount of force to produce a rotation or twisting motion to fix more firmly in place.	Torque the nut to 1000 inch-pounds.	1	2. Tighten	Torque (noun) length of wrenc handle times applied force.
Tow	To pull along (an aircraft) by means of a towing vehicle and tow bar.	Tow aircraft to the washrack.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Trace	To follow or study out in detail or step by step.	Visually trace the wiring diagram.	-		
Transfer	To convey or cause to pass from one place to another.	Transfer fuel and oil from one place to another.	1	2. Transport 3. Transmit	
Transmit	1. To convey or cause to pass from one place to another.	1. Transmit fuel and oil from one place to another.	3	1. Transfer 2. Transport	
	2. To send out a signal by radio waves or wire.	2. Transmit message to control tower.	-		
Transport	1. To convey or cause to pass from one place to another.	1. Transport fuel and oil from one tank to another.	2	1. Transfer 3. Transmit	
	2. To carry by hand or in a vehicle or hoist, or in a container, etc.	2. Transport landing gear to shop on dolly.	3	1. Move 2. Ship 4. Express	
Treat	To subject to some action, as of a chemical reagent; to bring a thing into a specified or implied condition.	Treat the barrels with a nonrustic water sealer.	1	2. Cure	
Trim	1. To free of excess or extraneous matter by or as if by cutting.	1. Trim patch to fit.	-		
	2. To adjust (a jet engine) to compensate for wear.	2. Trim the No. 1 engine.	-		

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Troubleshoot	To localize and isolate the source of a malfunction or break down.	Troubleshoot the landing gear control circuit.	-		
Tune	To adjust for precise functioning.	Tune the transmitter for maximum output.	-		
Turn	To cause to revolve about an axis or center.	Turn the door handle counter clockwise until latches retract.	3	1. Bend 2. Rotate 4. Warp	
Turn off	To shut off or stop the flow of by or as if by moving a control to its OFF position.	Turn off power to the signal generator.	-		
Turn on	To cause to flow or operate by or as if by moving a control to its ON position.	Turn on power to the signal generator.	-		
Uncap	To remove a device for closing off the end of a tube with a male fitting.	Uncap and unplug all hydraulic lines.	2	1. Remove	
Underprint	To print in register before the final design is press run.	Underprint all graphs before taking them to processing.	2	1. Proof	
Unite	To put together so as to make one; to join.	Unite the data into one graph.	3	1. Join 2. Fuse 4. Weld 5. Connect	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Unlock	To set free from an inactive or fixed position, to unfasten, to detach interlocking parts.	Unlock the parking brake.	3	1. Release 2. Disengage	
Unplug	1. To detach or separate (an electrical device) from a service outlet.	1. Unplug the soldering iron.	2	1. Remove 3. Disconnect	
	2. To remove a device for closing off the end of a tube with female fittings.	2. Unplug and uncap all hydraulic lines.	2	1. Remove plugs	
Unscrew	1. To loosen or withdraw by turning in the proper direction.	1. Unscrew the jack pad.	-		
	2. To draw the screws from.	2. Unscrew twelve screws around cover.	2	1. Remove	
Unwind	To cause to uncoil or unroll.	Unwind hoses from hose rack.	-		
Use	To put into action or service; to avail oneself of; to carry out a purpose or action by means of.	Use only antimagnetic fasteners.	1	2. Utilize 3. Employ	
Utilize	To put into action or service; to avail oneself of; to carry out a purpose or action by means of.	Utilize only antimagnetic fasteners.	2	1. Use 3. Employ	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Vacuumize	To remove air from a filled container prior to closing.	Vacuumize the test container before running the specimen.	3	1. Deflate 2. Depressurize	
Varnish	To coat with varnish.	Varnish the surface before displaying.	4	1. Coat 2. Cover 3. Paint	
Verify	1. To confirm or establish that a proper condition exists.	1. Verify that the light is off.	2	1. Be sure 3. Check 4. Determine 5. Ascertain	
	2. To establish the truth or accuracy of.	2. Verify the readings before recording them.	-		
Wait	To suspend activity in a sequence of activities until a given condition occurs or a given time has elapsed.	Wait five minutes before performing the next task.	-		
Wash	To cleanse by or as if by the action of liquid; to remove (dirt) by rubbing or drenching with liquid.	Wash the battery with a cleaning solution and a stiff brush.	-		
Watch	To visually take note of, to pay attention to in order to check on action or change.	Watch the indicator for changes in airspeed.	2	1. Observe 3. Monitor	
Warp	To turn or twist out of shape.	The test resulted in a warped specimen.	3	1. Bend 2. Turn	

VERBS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE	NOTES
Weave	To interlace or entwine; to knit.	Weave the twine to secure the top of the box.	2	1. Braid 3. Lace	
Weld	To incorporate or join together two pieces of material when they are in plastic or semifused condition without the use of solder, adhesives or other bonding materials.	Weld the two metal joints together.	2	1. Join 3. Unite 4. Fuse	
Wet	To increase the water content; saturate with fluids.	Wet the substance down.	1	2. Dampen 3. Moisten 4. Humidify	
Wire	To provide with wire; to use wire on.	Wire the circuit.	1	2. Install	
Withdraw	To take back, away, or out.	Withdraw the bar magnet from the center of the coil.	-		
Wrap	To wind, coil or twine as to encircle or cover something.	Wrap the wire around the terminal.	-		
Yield	To undergo permanent deformation under conditions of stress such as sheer, compression, or tension.	Yield the specimen to severe conditions.	2	1. Collapse	
Zero	To bring to a desired level or null position.	Zero the protractor to the surface.	-		

CONJUNCTIONS

CONJUNCTION LISTS

A list of conjunctions is given here to help our packaging engineers and technicians to write better Job Performance Aids (JPAs). Conjunctions are often used to make the long pungent statements needed in engineering. Changing writing styles for JPAs can be simplified by recognizing conjunctions and not using so many of them. Never tie two simple sentences together with a conjunction. Let them stand alone.

There are some conjunctions that should not be used in JPAs. They are poetic or are used in legal documents. Some of these are:

Ere
Whence
Whereat
Wheresoever
Whereinto
Wherewith
Whither
Why

Most of the adverbs used as conjunctions should not be used in JPAs. The two noted exceptions are "when" and "where."

A conjunction should never be the first word of a sentence. This makes for arduous reading of JPAs.

NOTE: The example sentences are not structured for JPAs. Most of them are combining two simple sentences into a compounded dialog that should be avoided. It was found to be an impossible task to hold to the 15 word sentence concept of JPAs and use most of the conjunctions properly.

CONJUNCTION LIST

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE
Also	Also implies the meaning of likewise or in addition to; most often leading to a complementary statement.	The humidity in the chamber should be closely watched, also the temperature must be closely watched.	2	1. And
Although	Although is used to imply a condition to a statement.	Most adhesive tapes are capable of withstanding a tensile load of fifty to sixty pounds, although there are some capable of withstanding three hundred or more pounds.	1	2. Though 3. Provided 4. Notwithstanding
And	And is used to continue a statement or introduce an equal statement.	Shipping regulations govern the constructions of cargo containers and set forth the procedures for loading the materials within common carriers.	1	2. Also
As	As is used to compare a statement with another statement.	The dimensions of the container are very important, as are the contents of the container.	1	2. For
Because	Because assigns a cause or reason to a given statement.	Humidity is of prime concern to the packaging engineer because it possesses great deterioration effects on metal.	1	2. Since 3. For

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE
Both	Both is used to present two items with a likeness or common cause.	Packing a container is one of the foremost problems to a packaging engineer, both size and weight are to be considered.	1	
But	But introduces a contradictory condition.	The container may be suitable for tropical climates, but it may not be suitable for artic conditions.	1	2. However 3. Still 4. Nevertheless 5. Yet
Either (or)	Either sometimes used with or, implies the choice of two statements. Or may be used in the place of either.	The container should be designed for easy inspection of humidity, either unpacking or direct dial readouts are available to the packaging engineer.	1	2. Or
Except	Except clamps a restriction or limitation onto a statement.	The boxes are to be rectangular in shape, except for two of which are to be square.	1	2. Unless 3. Save 4. Without
For	For relates a cause or reason to a statement.	The dimensions of the container must be accurate for loading the container into the cargo compartment.	3	1. As 2. Because

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PRFF. RANK	SYNONYMS BY ORDER OF PREFERENCE
Forasmuch	Forasmuch is used as a specific case of for especially followed by as; forasmuch as.	See FOR.	2	1. For
However	However relates a limitation to a given statement.	The number of items to be packaged is determined by the size and shape of the item; however, other factors can also be used.	2	1. But 3. Still 4. Nevertheless 5. Yet 6. Where 7. Wherever
If	If is used to imply a direct condition or provision.	Test results are acceptable, if the standard procedures are closely followed.	1	2. Provided
Lest	Lest connects a negative reaction or condition to a statement.	The test is invalid, lest the proper requirements are met.	2	1. Unless
Neither (nor)	Neither, sometimes used with nor, implies two unacceptable choices or solutions. Nor may be used in the place of neither.	Humidity has a detrimental effect on metals, neither corrosion nor deterioration can exist without it.	1	
Nevertheless	Nevertheless is usually applied when relating opposition or unlikliness.	The pallets are similar in composition, nevertheless they behave differently under stress.	4	1. But 2. However 3. Still 5. Yet

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE
Notwithstanding	Notwithstanding implies the meaning in spite of the fact that.	Most packaging engineers are primarily concerned with humidity ranges between 30 & 50%, notwithstanding the electronics aspects which require humidities below 5%.	4	1. Although 2. Though 3. Provided
Or	Or is a coordinating particle that marks an alternative.	See EITHER.		1. Either
Provided	Provided is a conditional particle denoting a limitation, restriction, or an exception.	The minimum number of containers necessary to house the complete item should be used, provided it is consistent with logistics flow and safety regulations.	3	1. Although 2. Though 4. Notwithstanding
Save	Save implies an exception to a given statement.	Five pallets have satisfactorily completed testing procedures, save two to be conditioned.	3	1. Except 2. Unless
Seeing	Seeing implies the meaning of noticing or considering and is usually followed by	The forklift was used to lift the heavy containers, seeing that grooves were prefabricated in the bottom of the containers.	1	
Since	Since introduces an explanatory statement.	Plastic and metal pallets are becoming more popular since wood is becoming scarce.	2	1. Because 3. For

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE
So	So is most often used to indicate a result of a given statement.	Item characteristics are primarily intended to provide a means of grouping items, so a minimal effort may be used.	1	
Still	Still is usually associated with a fixed opinion, choice, or decision.	There are many modes of transportation available to the packaging specialist, still the fastest means available is by aircraft.	3	1. But 2. However 4. Nevertheless 5. Yet
Than	Than denotes the inferiority of that which follows to that which precedes.	A drop test is more applicable for determination of the qualities of heavy containers than a long term vibration test.	1	
That	That is used to introduce a statement of cause, reason, purpose, consequence, or result.	The safe transportation of a container is the most important aspect that is required by packaging engineers.	1	
Therefore	Therefore is used to introduce a conclusion or consequence.	The first step of the tape test was successfully completed; therefore, step two may now be initiated.	1	2. Wherefore
Though	Though is used in implying a condition.	The results of the test are completely acceptable though better results were anticipated.	2	1. Although 3. Provided 4. Notwithstanding

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE
Till	Till is used when a statement of continuence or expectancy is used.	Similar packaging techniques for like items should not be used till it is determined that the item is similar in all respects.	2	1. Until
Unless	Unless denotes a contradictory result of a condition.	Packaged items that have been tested and failed usually remain in storage, unless they are needed for examination.	2	1. Except 3. Lest 4. Save 5. Without
Until	Until is used primarily in place of till.	See TILL.	1	2. Till
When	When implies a specific time.	Items are generally considered to be highly resistant to shock and vibration when bracing and blocking is all that is required of the container.	1	2. Whereas
Whereas	Whereas denotes an alternative.	The metal pallets showed little effects from the heat and concentrated loads, whereas the plastic pallets showed significant effects.	2	1. When
Whereby	NOT PREFERRED	NOT PREFERRED		
Wherefore	Wherefore is used to introduce a conclusion or consequence.	The tape has successfully passed the tensile strength test wherefore the tape should now be tested for adhesive qualities.	2	1. Therefore

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE
Wherein	Wherein implies the meaning in which.	Vibration is an oscillation wherein the quantity is a parameter that defines the motion of mechanical system.	1	
Whereof	NOT PREFERRED.	NOT PREFERRED.		
Whereto	NOT PREFERRED.	NOT PREFERRED.		
Whereupon	NOT PREFERRED.	NOT PREFERRED.		
Wherever	Wherever implies the meaning of a place.	Cost is an important factor in packaging, wherever the least expensive material may be used it will be preferred.	3	1. Where 2. However
Whether	Whether introduces an implied question or alternative.	Equally important to preservation is the requirement for uniform methods and materials, whether an item is packaged by a manufacturer or an Air Force depot.	1	
While	While implies the meaning of time or contradiction.	The military packaging expert must sometimes design an item without full knowledge of the conditions it will be exposed to, while the commercial packing experts have no doubts about conditions.	1	

CONJUNCTIONS	DEFINITIONS	EXAMPLES	PREF. RANK	SYNONYMS BY ORDER OF PREFERENCE
Without	Without implies an exception.	The packaging engineer should design the package without the need for repacking.	3	1. Except 2. Unless
Yet	Yet usually implies some opposition or unlikeliness.	The packaged containers are similar in appearance, yet are very different in use.	5	1. But 2. However 3. Still 4. Nevertheless

EXAPLES FROM
TO 00-85-37
FOAM-IN-PLACE PACKAGING

TECHNICAL ORDER

(JOB GUIDE MANUAL)

FOAM-IN-PLACE PACKAGING

F34601-73-D-1388

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

Air Force OC, 14 Apr 75-800

1 APRIL 1975

SECTION I

INTRODUCTION

1-1. PURPOSE.

1-2. This technical order provides instructions and guidelines for usage of polyurethane foam for cushioning and/or blocking and bracing packing techniques. Techniques may be varied at AFLC/ALCs depending on the characteristics of the foam used.

1-3. SCOPE.

1-4. Foams referenced within are manufactured by the packer(s) on site from combinations of premixed liquid foam generating chemicals.

1-5. EXPLANATION OF TERMS.

BATCH	Expanded or cured foam produced by hand mixing required amounts of foam generating chemicals.
BEARING STRESS	Weight of item on each square inch of the surface. Determined by dividing the weight (lbs) of the item by the surface area (sq. inch) of the item.
BLOCKING & BRACING	Methods used to prevent movement of item in its container or fixture.
BLOWING AGENT	Component that vaporizes during mixing of foaming chemicals and causes expansion of foam mass.
CATALYST	Component that accelerates chemical reaction between components.
COMPRESSIVE STRENGTH	Maximum load that a cross sectional area of foam can support before compressing. Generally expressed in pounds per square inch.
CONTAINER	Fiberboard box unless otherwise stated.
CORE DENSITY	Density of foam prepared under laboratory conditions of controlled temperature and humidity, allowed to free rise in a container of specified dimensions.
CREAM TIME	Period between "pour mixing" of foaming chemicals and start of foaming action.
CURING TIME	Period between "pour mixing" of foaming chemicals and final solidification or setup of the foam.
DISPENSING EQUIPMENT	Apparatus used to mix chemicals and automatically dispense foam.
ENCAPSULATION	Completely surrounding item with foam.
EXOTHERMIC	Referring to heat generated during chemical foaming action and confined within the foaming/foamed mass.
FIP	Foam-In-Place. A packaging process involving dispensing mixed chemicals, which expand and solidify, into an exterior container to provide cushioning and/or blocking and bracing for item protection.

FLEXIBLE FOAM	Possesses ability to return to original shape after compression. Provides cushioning against shock from impact. Cell structure permits free air flow through foam.
FOAMING BUCK	Frame placed around a container to prevent container sides from bulging during FIP operation.
FOAMED-IN-BAGS	Foaming components poured into ends of polyethylene tubing positioned around item in a container. Resultant cushioning is reusable. Patented process-free governmental use.
ITEM FRAGILITY	Threshold amount of shock a item can withstand and function properly. Generally expressed in forces of gravity units (Gs).
FRIABILITY	Degree or amount of surface dusting (particle separation) from a packaging material.
FROTHING	Three component FIP mixing process. Two are mixed and combined with a blowing agent resulting in a partial foam expansion before final dispensing.
G	A ratio between a given or measureable acceleration of a body and the acceleration due to gravity.
G FACTOR	Magnitude of G to which an article can be subjected without damage. Used to express fragility of the item.
K FACTOR	Rate of heat flow through a material. Reference unit of measurement expressing heat insulation value of a material.
MIXING RATIO	Amount of individual chemical components, expressed by weight, volume or part, required to mix desired type, density, etc., of foam.
OSHA	Occupational Safety and Health Act.
OSHA STANDARD	Regulations which are comprised of national consensus standards and established Federal standards and are contained in Occupational Safety and Health Act Standards and Interpretations.
PLASTICIZER	A material used to prevent hardening of residual foam in the plumbing of foam machines. A common plasticizer is Diallylphthalate.
POLYETHYLENE	Plastic film conforming to Federal Specification L-P-378, plastic sheet and strip, thin gauge, polyolefin.
POLYOL BLEND	Component B. Contains catalyst and polyhydroxy compound (see Section II).
POUR-(ING)	Dispensing of mixed foam generating chemicals into a container by automatic dispensing equipment.
PRE-POLYMER	Component A. Contains the isocyanate compound (see Section II).
RELEASE AGENTS	Polyethylene film, waxes. Substances used to prevent foam from sticking to the item packaged and/or the container or mold.

RIGID FOAM	Possesses little or no ability to return to its original shape after compression.
RISE TIME	Elapsed time between foam pour and majority (95%) of foam expansion after pouring.
SKIN EFFECT	Higher density cured foam wall thickness caused by foam expansion restriction (by container walls), premature heat dissipation and/or chemical additives.
TACK FREE TIME	Elapsed time between foam pouring and period when semi-cured foam may be touched lightly without stickiness.
TOXIC	Poisonous
VISCOSITY	Ability of a liquid to resist flowing. Major factor in efficient and effective mixing of chemical foam generating components.

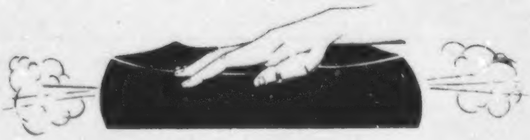
SECTION III

FOAM GENERATING COMPONENTS, PROCESSING AND DISPENSING EQUIPMENT

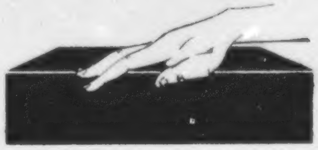
3-1. POLYURETHANE FOAMS (FIP).

3-2. Types, classes, grades and formulations of foams are cited in MIL-P-26514, Polyurethane Foam, Rigid or Flexible, For Packaging.

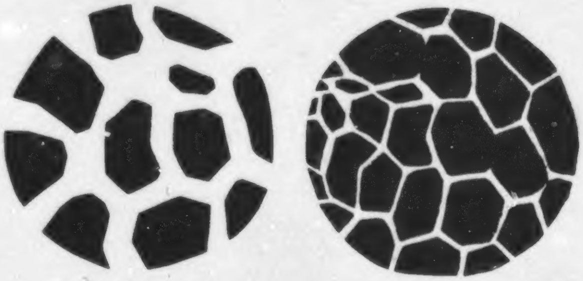
3-3. Flexible foams (Class II) are used primarily for cushioning applications in packaging.



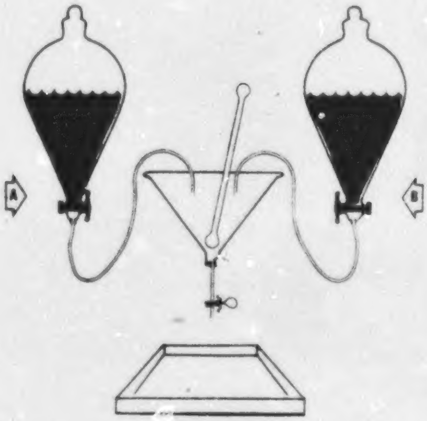
3-4. Rigid foams (Class I) are used primarily for blocking and bracing applications in packaging.



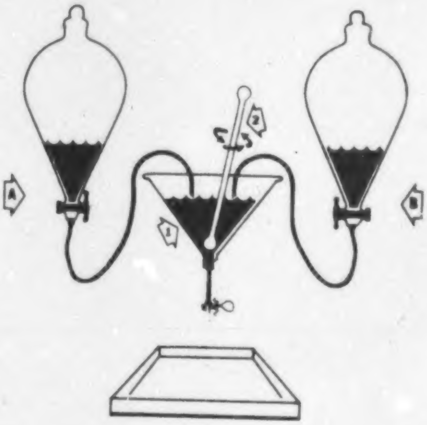
3-5. Foam density is applicable to both flexible and rigid classes. This term applies to foam cell structure. Foam formulations are available for different density foams.



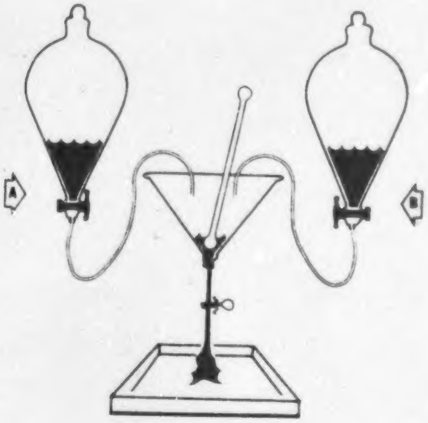
3-6. Packaging foams are comprised of Component A and Component B.



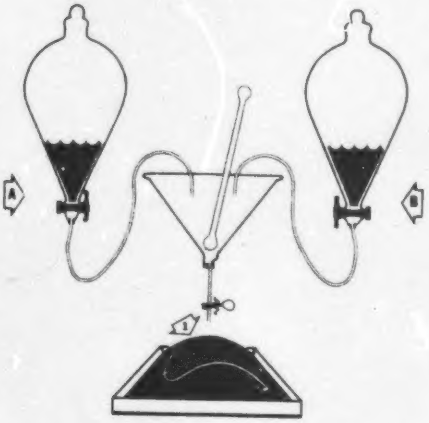
3-7. Specific amounts of Component A and Component B are mixed (1). This mixture is blended mechanically, pneumatically or manually.



3-8. This mixture is poured or squirted into the container space where cushioning or blocking and bracing material is desired.



3-9. Foam expands 30 to 100 times its original volume depending upon the component mixture used.



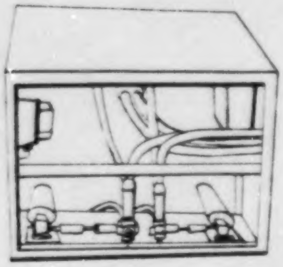
3-10. Experience is the best teacher of how much foam-mix to use to produce the desired amount for a pack.

3-11. FOAM DISPENSING PROCESS.

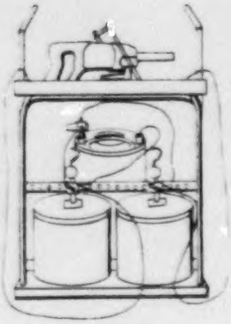
3-12. Foams can be dispensed automatically in froths and liquids by mechanical pump type and pneumatic dispensers.

3-13. AUTOMATIC FOAM DISPENSERS.

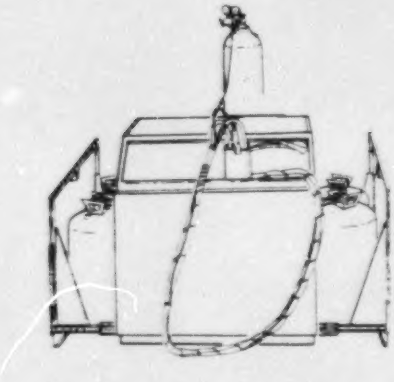
3-14. Mechanical dispensers employ variable speed rotary pumps to deliver specific amounts of foaming components from their containers, through hoses, into a mixing chamber or head/gun.



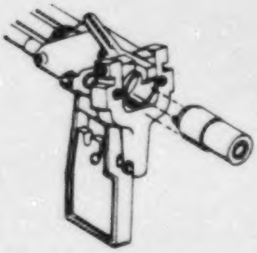
3-15. Direct pressure dispensers use pre-pressurized component containers or external compressed air/gas sources to propel component from their containers, through hoses, into mixing chamber or head/gun.



3-16. Pressure, piston type dispensers are similar to direct pressure types but have piston pump chambers to meter amounts of components to mixing head/gun more efficiently.



3-17. Mixing heads/guns are manually hand triggered, presetting-automatic push button operated or combinations thereof.



NOTE

Follow individual manufacturer's instructions when operating any type of foam dispenser.

3-18. Component carrying hoses, metering and mixing chambers, heads/guns and other dispenser units must be kept clean by periodic flushing and manual cleaning.

CAUTION

Avoid foam solvent contacts on plastics and rubber.

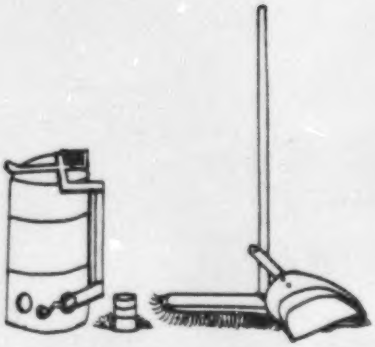
3-19. Methylene Chloride (Dichloro-Methane) is a common solvent for foam generating components.

3-20. Many urethane chemicals must be temperature conditioned per manufacturer's instruction.

3-21. Isocyanates are basically water reactive chemicals and should avoid contact with high humidity or moisture. A nitrogen blanket can be used to avoid reaction.

3-22. A plasticizer should be used to preserve and protect the working parts of the equipment during prolonged periods of inoperation or when transferring from one type of foam to another.

3-23. A common cleaning solution for spilled foams which have cured is a solution containing Dichloromethane Formic Acid, and Phenol.



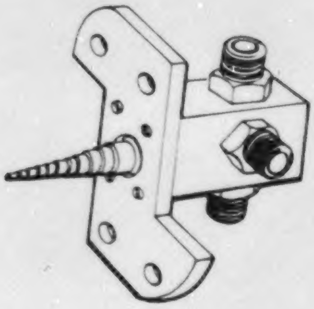
3-24. Clean up all foam and/or component spills immediately.

SECTION V

FOAM-IN-PLACE PACKAGING/PACKING TECHNIQUES

5-1. ITEM PREPARATION FOR FOAM-IN PLACE PROCESSING.

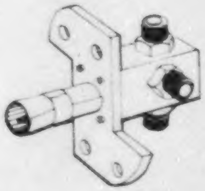
5-2. Item should be cleaned and preserved as required. Loose parts must be contained or secured to avoid loss or damage.



NOTE

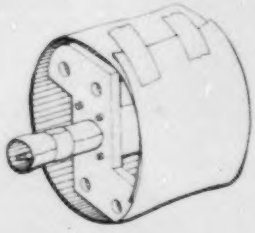
Use vapor barrier heat sealed bag with or without desiccant/VCI to enclose item if required.

5-3. All projections, sharp points extensions and hollows shall be padded/cushioned as required.

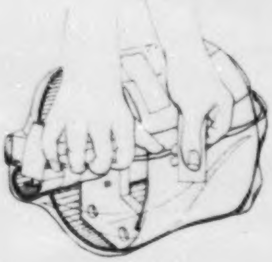


CAUTION

Foam adheres to most surfaces and removal process may damage item.

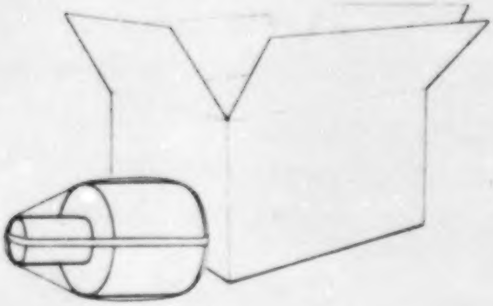


5-4. Wrap prepared item in polyethylene film and tape seal if basic method of item preservation does not protect it from foam.

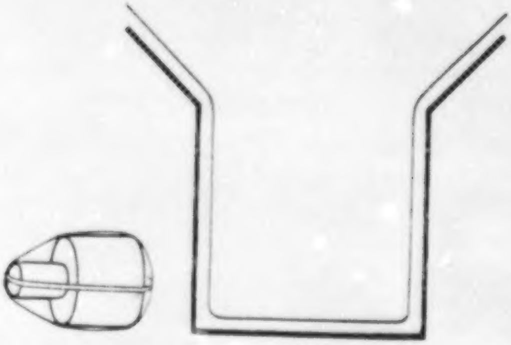


5-5. SPLIT PACK.

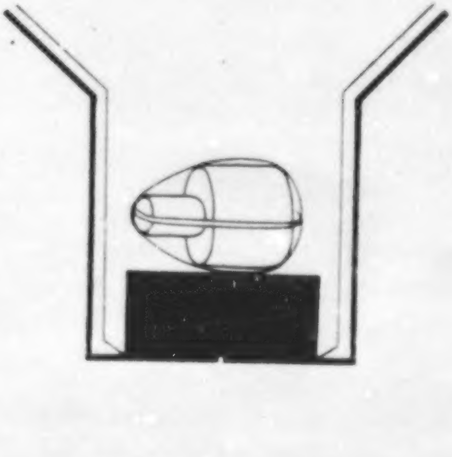
5-6. Select container to hold prepared item and required thickness of foam.



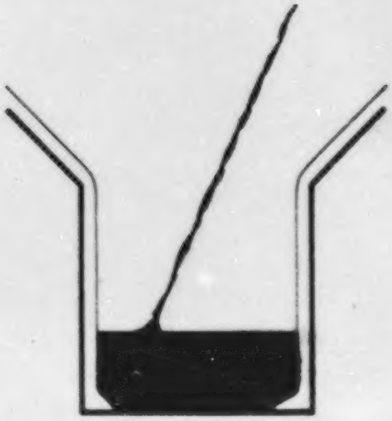
5-7. Drape sheet polyethylene film loosely inside container covering bottom and extending to flap. Tape, if necessary, to hold temporarily.



5-8. Place foam support block (to support weight of prepared item to required height) in container bottom. Position it to support item uniformly if necessary.



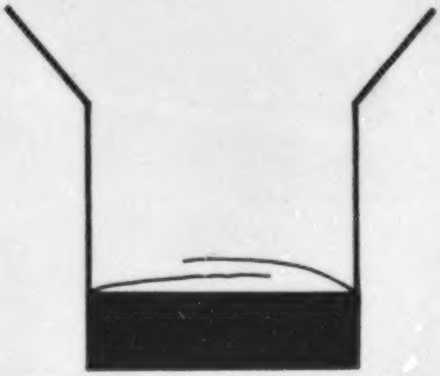
5-9. Dispense enough foam mix into the container to surround block and rise to the same height.



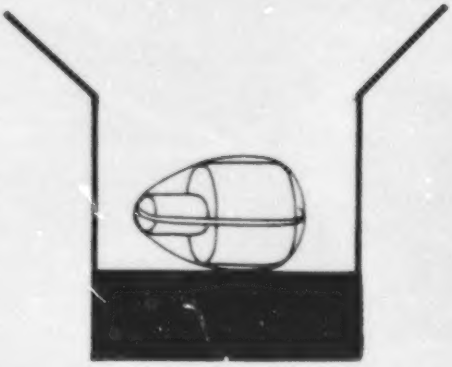
5-10. Fold polyethylene film inward completely covering foam after its rise.

NOTE

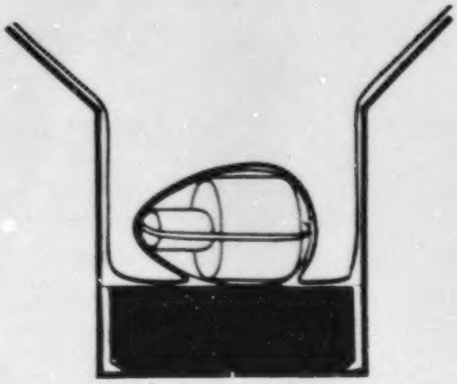
Omit paragraphs 5-7 and 5-10 if container (pack) is to be reusable for shipment/storage of like items. Proceed with paragraph 5-11 after protecting item from uncured foam.



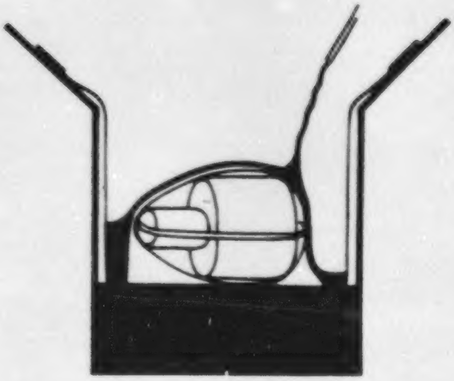
5-11. Place prepared item, centered, on top of the block.



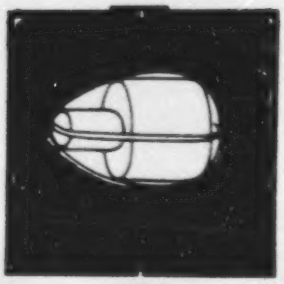
5-12. Drape sheet polyethylene film loosely inside the container covering prepared item, foam and extending to flap tops. Tape, if necessary, to hold temporarily.



5-13. Dispense enough foam mix into the container to surround item and fill container slightly above the top.

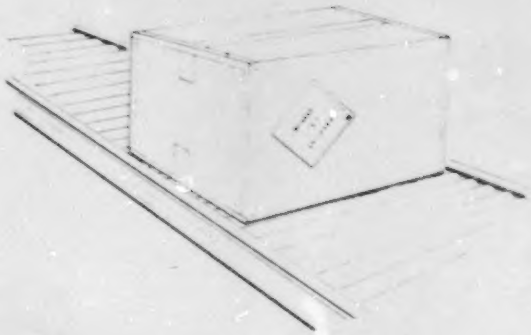


5-14. Fold the polyethylene film inward when certain rising foam will fill the container. Close flaps, tape. (If overfilled, trim off excessive foam before taping permanently.)



5-15. Before moving allow time for foam to set.

5-16. Marking for shipment/storage can be accomplished if container is not premarked. (Opening instructions displayed on container may facilitate easier item removal.)

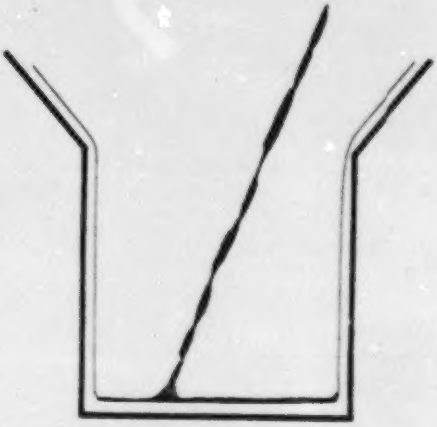


5-17. ALTERNATE SPLIT PACK.

5-18. Select container to hold prepared item and required thickness of foam (5-6).

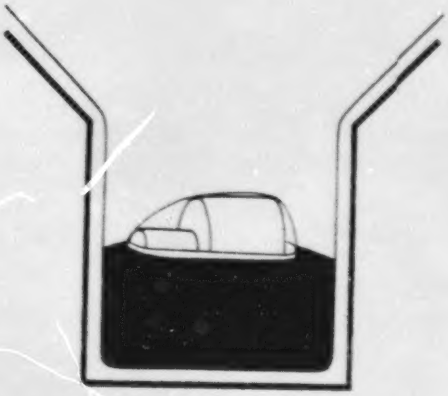
5-19. Drape sheet polyethylene film loosely inside the container covering bottom and extending to flaps. Tape, if necessary, to hold temporarily (5-7).

5-20. Dispense enough foam mix into the container to fill it half full after foam has risen.



5-21. Place prepared item, wrapped in polyethylene film, on foam surface (centered) after foam has risen and set enough to support the item weight.

5-22. Follow paragraphs 5-13 through 5-16.



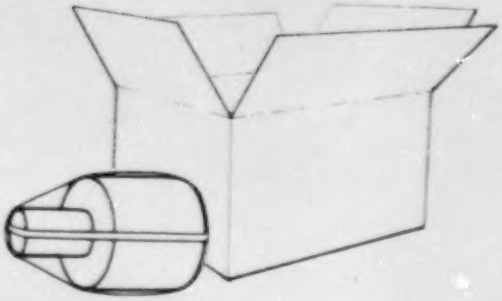
5-23. INVERTED PACK.

5-24. Follow steps included in 5-1 Item Preparation for Foam-In-Place Processing.

5-25. Select container to hold prepared item and required thickness of foam.

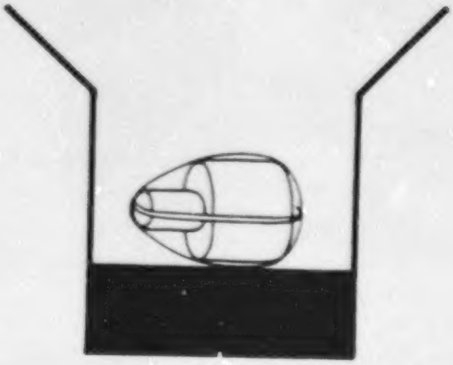
NOTE

> If containers are premarked, tape top shut and turn upside down. Open bottom for packing entry.

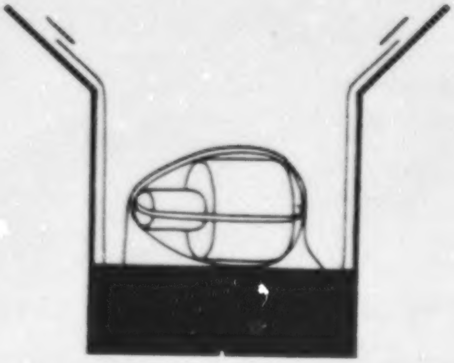


5-26. Cut block(s) of flexible foam the same length and width as the container inside with a depth equal to the required foam thickness.

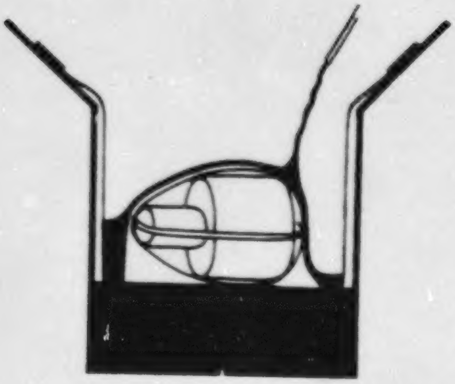
5-27. Place foam block(s) into the container. Place prepared item, centered on top of the foam block. (Turn item upside down if item has a top and bottom.)



5-28. Drape sheet polyethylene film loosely inside the container covering prepared item, foam and extending to flap tops. Tape, if necessary, to hold temporarily.

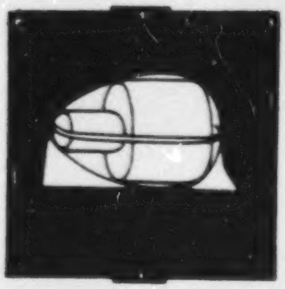


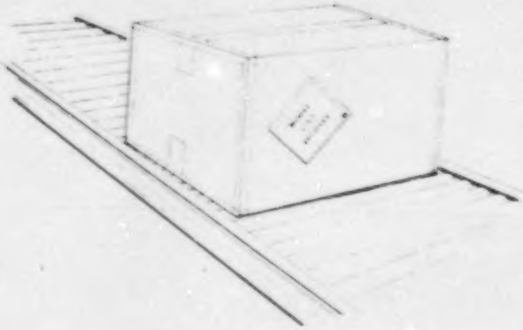
5-29. Dispense enough foam mix into the container to surround item and fill container slightly above the surface level.



5-30. Fold the polyethylene film inward when certain rising foam will fill the container. Close flaps, tape. (If overfilled, trim off excessive foam before taping permanently.)

5-31. Foam must be able to support item weight BEFORE container is turned upright. Allow ample setting time.



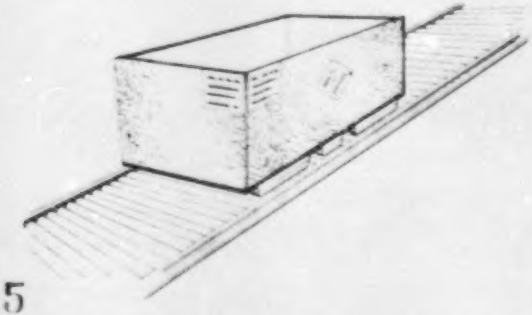


5-32. Marking for shipment/storage can be accomplished if container is not premarked. (Opening instructions displayed on container may facilitate easier item removal.)

5-33. TOPLESS PACK.

NOTE

This method is often used to ship heavy bulky or bulky items intended for immediate use. Plywood boxes with handling and stacking provisions can be used.

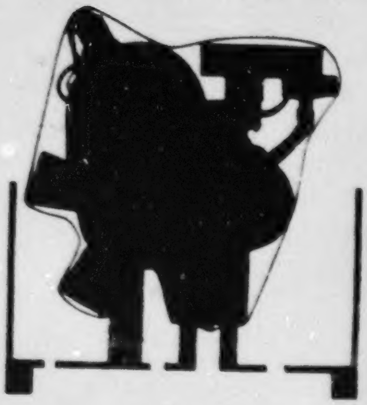


5-34. Follow steps included in 5-1 Item Preparation for Foam-In-Place Processing.

CAUTION

The foam should extend up to the prepared item's center of gravity.

5-35. Foam blocks or foamed bags may be used in the container to support the prepared item if its configuration and weight permits.



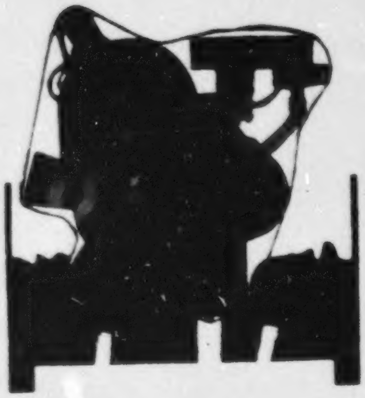
NOTE

The prepared item may extend 1/2 to 1/4 of its total height above the container.

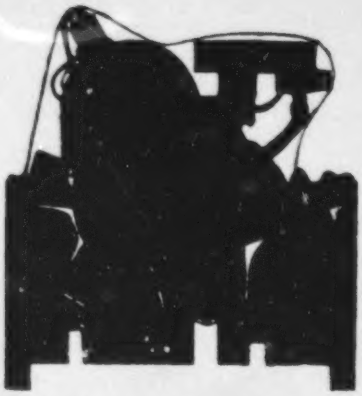
5-36. Required drain holes in container bottom (including areas sectioned off by support blocks) must be provided and not blocked after pack is completed.

5-37. Use two operations to dispense the required amount of foam mix into the container.

5-38. Cover all bottom spaces with enough foam mix to rise half way up the container inside. Allow mixture to set.



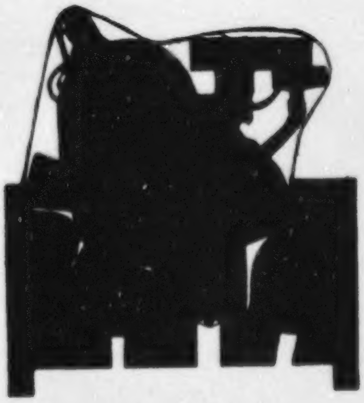
5-39. Add enough foam-mix to completely fill the container.

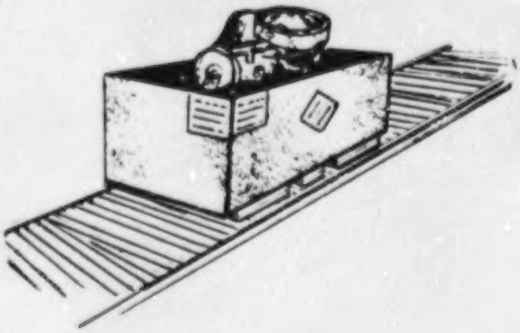


CAUTION

Avoid puncturing or damaging item wrap.

5-40. Trim off any excess foam above the container top level, if necessary, after foam has set sufficiently.





5-41. Marking for shipment can be accomplished if container is not premarked. (Item removal instructions displayed on container may facilitate easier item removal).

5-42. HANDLING PROVISIONS FOR HEAVY AND/OR BULKY CONTAINERS.

5-43. Rubbing strips can be fabricated using 15 inch long blocks of 4 inches x 4 inches and 3/4 inch plywood anchor strip 15 inches x 4 inches.

5-44. Cut required number of blocks and anchor strips to support container.

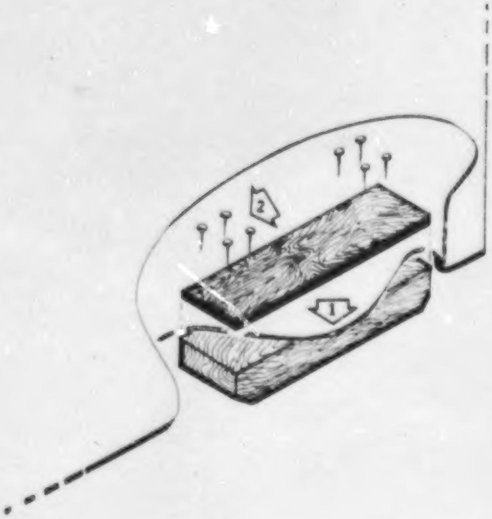
5-45. All 4 inches x 4 inches blocks must be half beveled at a 45° angle ($\pm 5^{\circ}$) on each end of the intended bottom side.

5-46. Before filling container position block(s), parallel to container width, under each container corner and spaced 4 inches inward from each bottom edge.

5-47. Place plywood anchor strips inside the container over the blocks and nail together.

5-48. Position and affix additional rubbing strips to the container if necessary to support container and facilitate proper handling.

5-49. Temporary supports (foam pads, blocks, plywood, etc.) may be used to elevate the container during foaming operations, handling and/or rubbing strip installation.



5-50. FOAM-IN BAGS.

5-51. Select appropriate container to pack prepared item. Proceeding guidelines may be used in selecting proper sized container.

5-52. Measure approximate length, width, and depth of prepared item. For dimensions to/including 6 inches, add 3 inches for CORRESPONDING CONTAINER DIMENSION

5-53. Greater than 6 inches not more than 12 inches, add 4 inches. Greater than 12 inches not more than 18 inches add 5 inches. Greater than 18 inches, add 6 inches for CORRESPONDING CONTAINER DIMENSION.

5-54. Polyethylene tubing in 12 inches (8135-782-7461), 15 inches (8135-782-7463) and 18 inches (8135-782-7464) widths can be ordered from GSA or fabricated as required from polyethylene film (L-P-378).

5-55. Rigid Foam.

Length of tube/bag = 2CD+CW+4 inches
Width of tube/bag = CL+CW+2 inches
Where: CL = Container Length
CW = Container Width
CD = Container Depth

L=2xCD+CW+4"

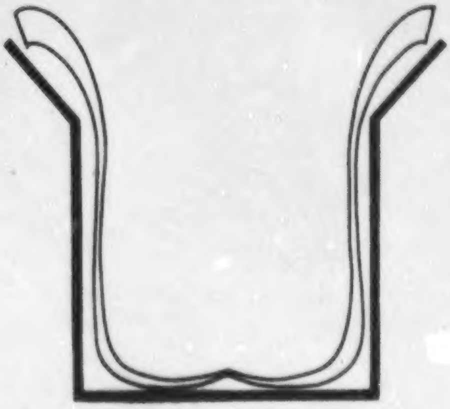
W=CL+CW+2"

5-56. Use number of tubes/bags necessary to immobilize prepared item in its container.

5-57. Cut adequate number of prefoamed blocks to support prepared item required height above container bottom during foaming.

NOTE

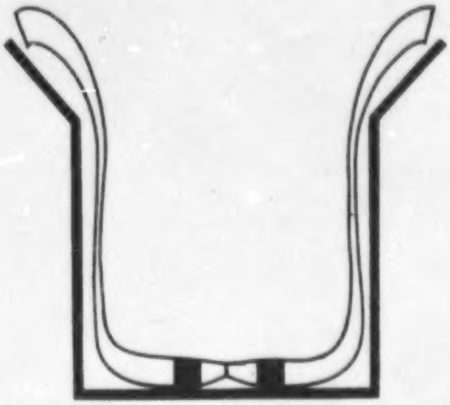
Use prefoamed blocks of same density as new foam if possible.



5-58. Place prefoamed blocks inside the bags/tubes and position both inside the container. (Blocks should be moved as close to the heat seal as practical.)

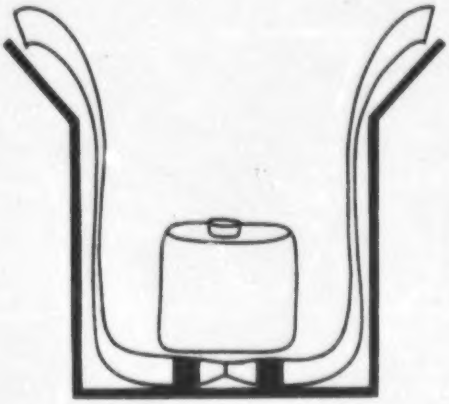
NOTE

The prefoamed blocks may be moved in any manner required to uniformly support prepared item in its container.

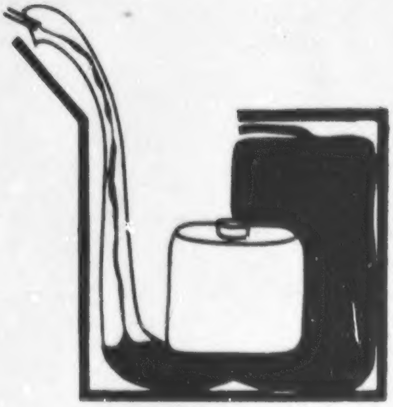


5-59. Tubes/bags may be taped, clipped, etc. to container walls to facilitate easier dispensing of foam mix into them.

5-60. Position prepared item in position as required in container.



5-61. Dispense equal amounts of foam mixture into each set of tubes/bags. When foam reaches 50% of its rise remove any tape, clips, etc. holding tubes/bags to container.



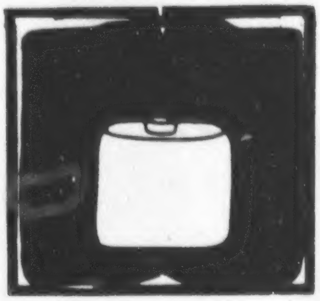
5-62. Overlap tube/bag ends and close container top. Secure temporarily until foam rise has stopped.

5-63. Allow foam to set before commencing extensive handling.

5-64. Tubes/bags may be prefoamed by using jigs, bucks, molds, etc. with appropriate dummy loads.

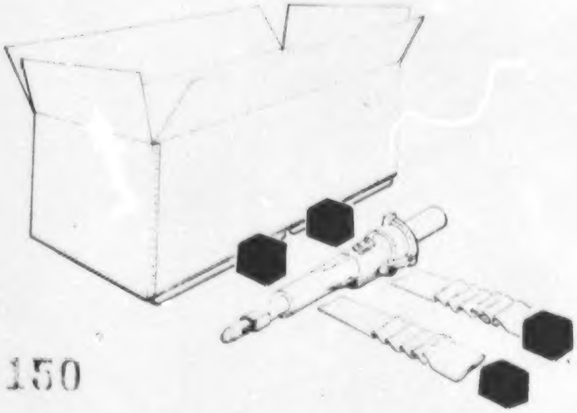
5-65. MULTIPLE TUBES/BAGS

5-66. Multiple tubes/bags may be used where item configuration makes single bag use impractical.



5-67. The number of tubes/bags used and placement will depend on their support requirements.

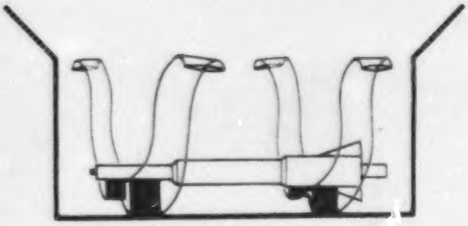
5-68. End caps or foam blocks may be used to immobilize the prepared item in its container if the tubes/bags fail to do so.



NOTE

> Consult appendix and/or Packaging Specialist/Engineer for assistance in determining tubing/bag WIDTH requirements for flexible foam use.

5-69. Cut film to desired length and twice the width allowing 2 inches for heating sealing. Fold lengthwise and heat seal.
5-70. Heat seal tube/bag across width in center forming two equal, end-to-end attached tubes/bags.



5-71. Calculate the length of the tubes/bags required using paragraph 5-55. The width = 12 inches (unless the item configuration requires variance).

NOTE

> Consult appendix and/or Packaging Specialist/Engineer for assistance in determining tubing/bag width requirements for flexible foam.

5-72. Follow paragraphs 5-56 through 5-64.

SECTION VI

REUSE OR DISPOSAL OF FORM-IN-PLACE PACKAGING

6-1. GENERAL.

6-2. Maximum effort should be made to effect reuse of foams.

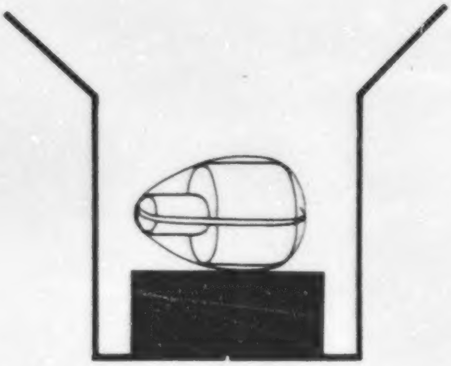
6-3. Ecological considerations should be of prime concern in the disposal of foam related refuse and residues.

6-4. REUSE.

6-5. Use undamaged foam packs in their original configurations to pack like items for shipment and/or storage.

6-6. Some damaged foam packs may be restored or repaired with new foam.

6-7. Foam blocks/pads cut from used foam can be used as support blocks/pads.



6-8. Cavities in split pack halves may be filled with new foam (amount necessary for rectangular configuration) and cut into blocks/pads after cured.

6-9. Flexible foams can be shredded or cubed, bagged and the bags used as dunnage. Unbagged material can be used as loose fill.

6-10. Chunks of used foam can be stuffed around items in containers in the event prescribed cushioning or dunnage materials are unavailable.

6-11. Foams can be integrated with new foam mix pours surrounding the item in the container.

6-12. Used foam materials can be sold as salvaged material. Consult your local Defense Property Disposal Office for inforamation.

6-13. DISPOSAL.

6-14. Consult Bioenvironmental Engineer for proper disposal instructions.

6-15. Consult Pacer Foam monitor at ALC in related geographic area for current disposal instructions concerning foam mix component containers.

6-16. Polyurethane foam will decompose when subjected to atmospheric, ultraviolet, infrared and fungus attack.

NOTE

> Decomposition time will vary depending on the exact chemical composition of the foam, size of pieces and the degree of foam exposure to ultra violet radiation.

6-17. The rate of decomposition under land fill disposal conditions can be accelerated if the waste foam is shredded, granulated or pulverized before disposal.

6-18. Disposal by incineration is the least desirable method. Contaminants are released into the atmosphere unless ideal incineration conditions exist. This generally is not prevalent.

NOTE

> AFM 91-11, Solid Waste Management, states the requirements for proper methods of waste disposal.

APPENDIX A

FOAM-IN-PLACE DESIGN CRITERIA FOR AFLC PACKAGING SPECIALISTS/ ENGINEERS ONLY.

A-1. GENERAL.

A-2. This section is provided primarily to assist packaging personnel responsible for design requirements to apply usage of flexible and rigid foams for packaging.

NOTE

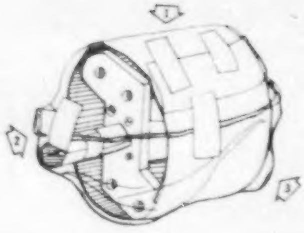
> Sections A-3 through A-22 pertain to flexible foams for cushioning. Sections A-23 through A-38 pertain to rigid foams. Sections A-39 through A-52 pertain to foam in bag-multiple tube/bag technique.

A-3. FLEXIBLE FOAM FOR CUSHIONING.

A-4. Follow steps included in 5-1 Item Preparation for Foam-In-Place Processing.

A-5. Determine the static bearing stress (psi) for each surface.

A-6. Next, determine the item fragility measured in g's.



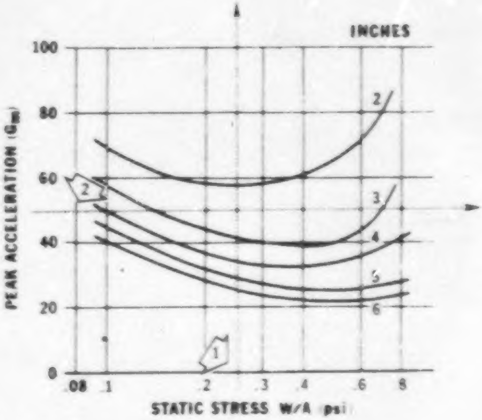
A-7. One way to find item fragility is to ask the manufacturer of the item if he has that information.

A-8. The Packaging Specialist/Engineer may have to estimate the item fragility, based upon his experience with similar items, if the item fragility cannot be found.

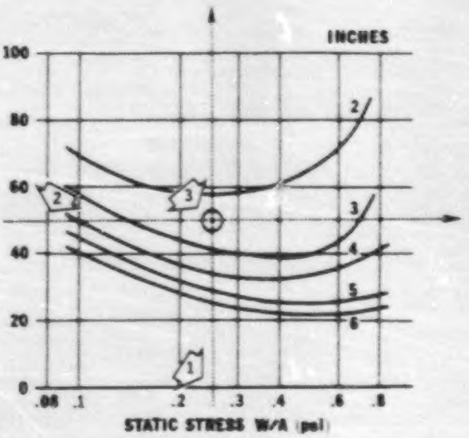
A-9. The thickness of foam needed may be found by looking at the cushion curves. (Attached Curves). All curves are for 30-inch drop.

A-10. To find foam thickness for each face of item draw a line upward from horizontal axis at point of static stress for that item face (1).

A-11. Follow a line drawn from the left (2) to a point on the vertical axis equal to the fragility estimated earlier.



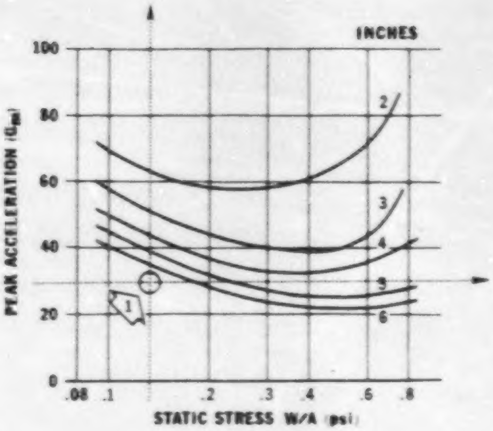
A-12. The point (3) when these two lines cross will be near one of the cushion curves on the graph.

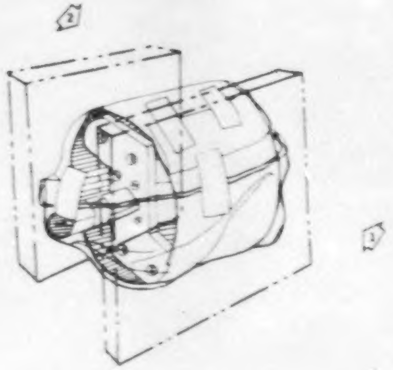


A-13. The closest cushion curve below crossing point will be the thickness of foam needed to protect face of the item in a 30-inch drop.

A-14. Repeat process for each of the other faces of the item. Use these values for each face or use the thickest for all faces for extra protection.

A-15. Do not package item in flexible foam if the point where the two lines cross is below the curves.





A-16. Add this thickness to each side of prepared item to find optimum container size.

NOTE

Greater thickness of foam may be used to allow use of standardized containers.

A-17. Do not use less than 2 inches of foam thickness.

A-18. Refer to Section 5 to find the correct foaming technique for your item.

A-19. When your package design is finished, a sample package should be foamed and drop tested, if a similar design has not been tested.

A-20. Test in accordance with MIL-P-116 or Federal Test Method Standard 101.

A-21. Repeat test using lower fragility or different cushioning material, if item breaks or any foam pads are broken, badly torn, or crushed.

A-22. When your design is finished find the total cost and compare with the old way of packaging the item to find savings.

A-23. DESIGN OF RIGID FIP PACKAGING.

A-24. Use Type II Class I Polyurethane Foam in accordance with MIL-P-26514 for blocking and bracing for foam-in-place packaging.

A-25. Use rigid foam for packaging application in conventional fiberboard, wood, metal, or plastic containers.

CAUTION

Rigid foam dissipates internal heat slower than flexible foam.

A-26. Is item sensitive to temperature up to 180°F?

A-27. Fabricate premolded foam pack using a dummy model, rejected part or a mockup to simulate the configuration and weight of the prepared item when in doubt.

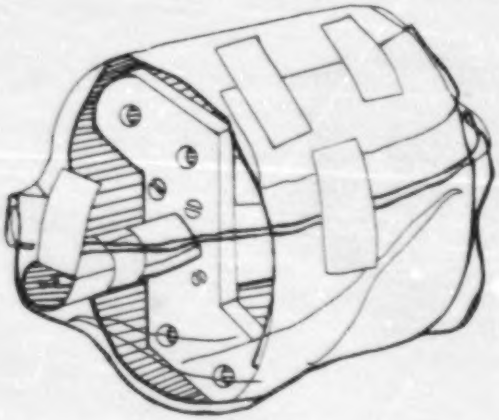
A-28. Remove the simulated item from the pack after the foam has cured and substitute the ACTUAL prepared item in its place.

A-29. Use appropriate FIP packaging/packing technique if item can be processed in this manner.

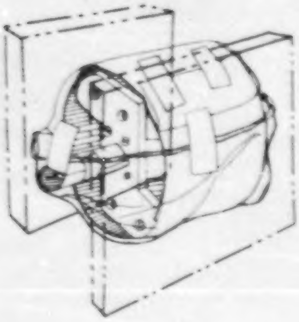
A-30. Follow steps included in 5-1 Item Preparation for Foam-In-Place Processing.

NOTE

Greater thicknesses of foam may be used to utilize standardized containers.



A-31. Use minimum of 2 inches of foam-in-place. Greater thickness may be required from calculations made of static stress.

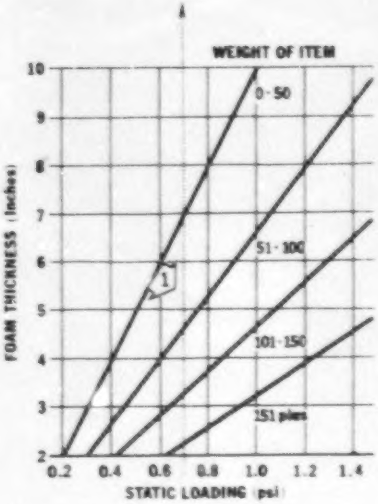


A-32. Determine static load, pounds per square inch (PSI), for each bearing surface.

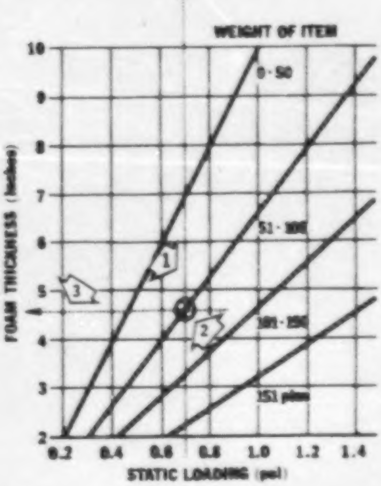
NOTE

Use attached curves to find thickness of foam required for top and bottom of item. (Unless testing has validated the use of a lesser thickness.

A-33. Draw a line upward from horizontal axis at point of static stress calculated for top and bottom faces of item.



A-34. Follow line to point of intersection of the weight of the item. At this point draw a line to left of vertical axis.



NOTE

Intersection at the vertical axis denotes thickness of foam.

A-35. Determine the thickness of foam required on the sides and ends of item using figure 5-2 and repeating the process of selection as above.

A-36 Determine inside dimension of shipping/storage container by adding, to the prepared item size, the thickness of foam required on each face.

NOTE

Greater thicknesses of foam may be used to allow use of standardize containers.

A-37. Select proper container to meet the transportation requirement.

A-38. Refer to Section V to find correct foaming technique for item.